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RESEARCH FOR MAINE FARMERS 52-

Sixty-Fifth Annual Report of Progress
Ending June 30, 1949

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The Maine Agricultural Experiment Station

University of Maine

Orono, Maine

Highmoor Farm, Monmouth, Maine, where research is conducted on apples, sweet corn, beans, and other vegetable crops.



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¹ Appointment effective after July 1, 1948.
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COMMENTS BY THE DIRECTOR

Research in any industry is an investment for the future. This is as true for agriculture as for any other industry. Research results in increased efficiency in production and marketing, and in better rural living. These results benefit producers, distributors, and consumers. Better methods and practices enable the farmers and market men to operate at a lower unit cost, thus providing food to consumers at a lower cost, or providing a higher quality product at the same cost. In either case the consumer benefits.

The Station has been fortunate in maintaining a staff of highly capable workers. Some improvement in the University salary scale has been helpful in obtaining replacements and in avoiding more than normal losses in the staff. During the past year, ending June 30, 1949, only four staff members were lost to the Station: Mr. C. W. White, associate chemist, died on January 23, 1949; and resignations became effective for Mr. Andrew E. Watson—assistant agricultural economist, Mr. Paul J. Eastman—assistant agronomist, and Mr. Gleason W. Wilson—superintendent at the Blueberry Hill Farm. New appointments during the year include Mr. Charles E. Cunningham as assistant in agronomy, Dr. Richard W. Gerry as associate poultry husbandman, Mr. Lyle Littlefield as assistant in horticulture, Mr. Irvin C. Mason as superintendent at Blueberry Hill Farm, Mr. Willard E. Savage as assistant in agricultural economics, and Mr. Alvah L. Perry as assistant agricultural economist.

A new department of Agricultural Engineering has been established as of July 1, 1949 to serve more fully in teaching and research work. The newly appointed head of this department is Mr. Frank W. Peikert, agricultural engineer, formerly of Michigan State College.

Dr. Frank P. Eggert of Cornell University has been appointed associate horticulturist and head of the Station Department of Horticulture effective September 1, 1949. He replaces Dr. Chester W. Hitz who resigned May 1, 1948.

The Station will benefit materially from the completion of the new Plant Science Building. The departments of Plant Pathology, Entomology, and Horticulture, now housed in Holmes Hall, will move to the Plant Science Building sometime early this fall. Holmes Hall will be remodelled and equipped, as funds become available, so as to better serve the research and service work by the Chemistry Department, particularly the work in food processing.

A detailed statement of the income and expenses of the Station is included on the last pages of this report. During the past year the

Station benefited from some increase in funds from the Research and Marketing Act of 1946, including an initial allocation of Title II funds for potato marketing research. Some increase in appropriations also was received from Potato Tax funds, Blueberry Tax funds, and sales of farm products.

Special appreciation is acknowledged for grants of funds, for assistance on specific projects, received from Eastern States Farmers' Exchange, Maine Cannery Association, Summers Fertilizer Company through James E. Totman, C. M. Cox Company, Kraft Foods Company, General Chemical Company, E. I. du Pont de Nemours Company, Sherwin Williams Company, Tennessee Corporation, and Maine Institute of Potato Starch Manufacturers. Funds also were received from Corn Tax receipts, through the Maine Department of Agriculture, for assistance on the corn borer project; and from the Department of Sea and Shore Fisheries, through the Maine Development Commission, for a study on lobsters. These funds are a valuable supplement to the income received from regular State and Federal appropriations.

This summary of progress during the past year has been prepared by Dr. George F. Dow from reports submitted by the research workers. Any who wish more detailed information on specific studies may write directly to the staff member listed for each study. The research program of the Station is planned to provide helpful information on the most important problems in the production and distribution of Maine agricultural products. It is our sincere hope that this research summary will be useful to the agricultural industry of the State and to research workers in other areas.

APPLES

APPLE BREEDING. R. M. Bailey. Of approximately 1500 trees resulting from controlled crosses, all but 300 have been discarded because of inferior fruit or tree characters. Several selections of promise have been propagated to permit further testing. New varieties received from other stations are in trial. No high quality winter varieties have been located as yet that appear superior to those already in use. Red Gravenstein, Milton, Linda, and Macoun, which are relatively new early to mid-season productions, appear to merit more extensive trial.

RESULTS OF HAND-THINNING MCINTOSH. R. M. Bailey, F. J. McDonald. Because of the exceptionally heavy set of fruit on McIntosh at Highmoor Farm in 1948, an experiment was conducted comparing the crop from 17 thinned trees, about 20 years of age, with an equal number of unthinned trees. Thinning consisted of removing all but

one fruit per cluster on all limbs that were readily accessible from the ground and stepladders. Limbs that were difficult to reach were not thinned because of the cost of labor.

The thinned trees yielded 13.5 bushels and the unthinned 14.5 bushels per tree. The size of apples was $2\frac{1}{2}$ " or more for 73.4 per cent of the yield from the thinned trees and 65.8 per cent from the unthinned trees. The partial thinning did not appreciably improve the color of the fruit. The increase in market value of the $2\frac{1}{2}$ " grade due to thinning did not any more than compensate the loss in value due to reduced yield in the $2\frac{1}{4}$ " grade. The cost of thinning, approximately \$1.70 per tree, appears to have been a loss when based entirely on the value of the 1948 crop. However, this cost may be partially regained if the thinned trees set a larger crop in 1949 than the unthinned trees.

PRE-HARVEST SPRAYS TO REDUCE FRUIT DROP OF MCINTOSH. R. M. Bailey, M. F. Trevett, J. H. Waring.¹ Magnesium sulfate applied four to five weeks before harvest at Orono and Highmoor Farm, at a concentration of 20 pounds magnesium sulfate to 100 gallons of water, exerted no beneficial effect in reduction of the fruit drop. Although there was no leaf scorching to indicate magnesium deficiency at Highmoor Farm, an analysis of soil samples showed a very low level of magnesium.

4-chloro-o-toloxycetic acid caused a slight decrease in the amount of drop, and App-L-Set containing sodium-1-naphthaleneacetic acid resulted in a substantial decrease in amount of drop. An application of App-L-Set at Monmouth on September 22 caused a decrease in percentage drop from 18 to 10 per cent up to October 2. A second application on October 1 reduced the total percentage drop from 32 to about 17 per cent for apples picked October 9. At Orono a single application caused a similar decrease as the initial application at Monmouth. The use of App-L-Set was considered profitable, resulting at Monmouth in a saving of 32 pounds of picked fruit per tree on October 2 and 65 pounds on October 9.

MCINTOSH FILLER MANAGEMENT. R. M. Bailey. The filler trees planted in one block at Highmoor Farm in 1928 were removed in 1943. In another similar block the fillers were "fanned" with increasingly intensive pruning each year until removed after the 1948 crop. During the 5-year period 1944-48, the retention of the fanned fillers reduced the yield of the permanents an estimated 14 per cent. The total yield of both fillers and permanents was 965 pounds per tree more than the expected yield if the fillers had been removed 5 years earlier. The com-

¹ Certain parts of this study were in cooperation with the College of Agriculture, University of Maine.

parative performance of the permanents in these two blocks over the next few years is needed before final conclusions can be drawn as to whether the fanning of the fillers was good management.

APPLE FERTILIZATION. R. M. Bailey, M. F. Trevett, O. L. Wyman.² The long-time fertilization experiment at Highmoor Farm indicates the value of a hay mulch. The annual application of 200 pounds per tree, in addition to inorganic fertilizer, resulted in an increased yield of about 30 boxes of apples per ton of mulch applied. The applications of 60 pounds each per acre of inorganic P_2O_5 and K_2O , in addition to 60 pounds of N, also appear to have been profitable except where applied with mulch.

The acidity of the topsoil has sharply increased throughout the orchard since 1940, with a drop in pH from 5.9 in 1940 to 4.3 in 1948. There are no apparent differences in pH associated with fertilizer treatments. The calcium level was recorded as "high" to "very high" for all plots in 1940, but "low" for all treatments in 1948. The magnesium level has also decreased from "medium high" to "very low" for all plots. These sharp changes since 1940 are surprising in view of the fact that no form of lime has been applied to the orchard, at least since 1930. The possible role of spray residues as associated with these rapid changes will be investigated.

The phosphorus level for all plots was "low" in 1940, but has increased to some extent in the topsoil with all treatments receiving mulch, but most noticeable where mulch has been applied with NPK. No change in the phosphorus level of the subsoil due to fertilizer treatments has been detected. The most significant soil change associated with the different treatments appears to be with potassium. All plots were rated as "medium" in potassium level in 1940. The level appears to have decreased somewhat in the topsoil in all plots (including NK and NPK) since 1940, except in mulched plots. In all mulch treatments, the potassium level has increased significantly in the topsoil and also slightly in the subsoil. Mulch has been more effectual in maintaining or increasing the potassium level than yearly application of inorganic potassium. These trends in soil fertility levels associated with mulch further emphasize its value to Maine orchards.

In another long-time fertilizer test in West Sumner, no significant differences have occurred as yet in yield, color, condition, or size of fruit for different fertilizer treatments using nitrogen, phosphorus, potassium and magnesium sulphate. As in previous years bitter pit was found most frequently on fruits from trees receiving magnesium sul-

² One phase of this study was in cooperation with the Maine Extension Service.

phate. However, bitter pit was not present during 1948 in sufficient quantity to impair quality.

SAWDUST AND SHAVINGS AS MULCH FOR APPLE TREES. M. F. Trevett, R. M. Bailey. A preliminary experiment to determine the value of sawdust and shavings as mulching materials with two levels of nitrogen application was started at Highmoor Farm, Monmouth in 1946. Yields of the mulched trees in 1948 were higher than those of the unmulched trees, but the difference was not statistically significant. The mulched trees had slightly larger fruits in spite of the fact that they were more heavily loaded. There was no significant difference in yields or fruit size between the two levels of nitrogen application. Several years data however will be necessary before definite conclusions are justified.

EUROPEAN RED MITE. F. H. Lathrop, M. T. Hilborn, B. E. Plummer, Jr., S. E. Northsen. The hot dry weather following midsummer in 1948 was favorable for the development of European red mite, and this pest again caused widespread injury in Maine apple orchards.

Trees that were dusted with eight applications of "Arathane" between petal fall and the end of July were infested with very low populations of red mites, and suffered little mite injury. Arathane also gave satisfactory scab control during this period. The other trees treated only with sulphur dust or "Fermate" dust were heavily infested with mites and suffered severe mite injury. The chlorophyl content of the leaves was markedly depleted, and the apples were smaller and had poorer color on the mite-infested trees.

In another orchard, trees sprayed through the season with glyoxalidine "C" suffered much less mite injury than adjoining trees which were sprayed with mild sulphur through the season. Scab control was satisfactory, and the foliage and fruit had better appearance on trees sprayed with glyoxalidine "C."

OYSTER-SHELL SCALE. F. H. Lathrop, S. E. Northsen. Two applications of 5 per cent DDT dust gave a high degree of control of oyster-shell scale again in 1948. One or two applications of liquid spray, containing 3 pounds of 50 per cent DDT wettable powder in 100 gallons of water, was equally effective. The proper timing of the applications was of great importance. The first application was made very promptly after the young, crawling scales first began to appear. The second application was made five days later. A third application, made four days after the second application, appeared to have little or no effect. The emergence of the young scales was very nearly complete, and practically all of the scales that had not been killed by the first two applications had settled and developed protective covers before the third application

was made. Even trees that had been very severely injured by the scales, made surprisingly rapid improvement in vigor after the infestation was subdued by treatment with DDT.

APPLE FRUIT FLY. F. H. Lathrop, S. E. Northsen. In the summer of 1948 the flies began emerging two weeks later than normal, and emergence continued well into August. Infestation of apples by the flies was delayed correspondingly later than usual. The very dry weather during late summer helped to retain the protective spray deposit on the trees, and to a considerable extent offset the effects of the late emergence of the flies. In experimental dust plots, applications of lead arsenate, continued until the end of August, gave very satisfactory control of fruit fly, in spite of heavy infestation of the apples in adjoining, untreated check plots.

APPLE SCAB CONTROL. M. T. Hilborn. Results during the past 4 years have indicated that several new organic fungicides control apple scab if the materials are applied thoroughly at the proper time. In order to give these newer materials a rather severe test, spraying was delayed at the prebloom stages until rain had fallen for at least 45 hours, and at the petal-fall stage until 18 hours after rain began. As was expected with this program, elemental sulfur gave poor leaf-scab control, and at harvest time over 8 per cent of the fruit was scabby. Phygon, Bioquin I (an organic fungicide containing copper), and a mixture of elemental sulfur and Dithane all held fruit scab to less than 1 per cent, and Good-rite z.a.c. and Arathane held fruit scab to 3 and 4 per cent respectively.

Various combinations of two fungicides, each at half strength, were also tried in this delayed program. A mixture of Puratized Agricultural Spray and Fermate, and a mixture of Puratized and elemental sulfur gave good control. A mixture of Bioquin I with elemental sulfur, Phygon, or Fermate, and a mixture of Phygon with either Fermate or elemental sulfur gave satisfactory control. Combinations of Puratized with Phygon and Bioquin I gave rather poor control of scab.

Concentrated sulfur applied to foliage by means of an air blast gave excellent control of scab. This phase of the apple spray program will be expanded in the future and concentrate spray applications of many organic fungicides will be studied.

SPRAY AND DUST DEPOSITS ON APPLE FOLIAGE. M. T. Hilborn, F. H. Lathrop, B. E. Plummer, Jr., A. S. Getchell. In 1948 when equivalent amounts of sulfur were applied, the greatest deposit on the foliage occurred when concentrate spray was used, second was with dusting, and the least was with spraying with hand guns. Deposits resulting

from concentrate spray applications were 3 times that of spraying with hand guns.

APPLE SPRAY BOOMS. M. T. Hilborn, F. H. Lathrop, F. J. McDonald, C. Crocker. In 1948 a new type of spray boom was constructed which gave very satisfactory results. The boom is a modification of the types previously built and is designed for spray pumps of 25 to 35 gallons per minute capacity. The design has been simplified so that the boom may be easily constructed in a home workshop.

INCOMPATIBILITY OF HARDY STOCKS. M. T. Hilborn. The list of varieties showing incompatibility with Tayezhnoie is increasing, and



FIG. 1. Apple Spray Boom Constructed at Highmoor Farm Gives Satisfactory Results and Saves Both Labor and Spray Materials.

this stock has now been eliminated from most of the test plantings. Manitof, a Canadian hardy stock, is showing incompatibility with some varieties and the Baldwin/Manitof trees became so poor in 1948 they were eliminated early in 1949. Florence Crab is definitely incompatible with Baldwin and this combination was eliminated from the Baldwin test block at Highmoor Farm early in 1949. Very promising new hardy stocks are becoming available for experimental use and 11 more kinds were added to the experimental plantings in 1949.

AMOUNT OF BRUISING IN HANDLING APPLES DURING THE VARIOUS PHASES OF MARKETING. H. C. Woodward. This is the second year the number and size of bruises on apples have been measured, comparing the results of careful and rough handling of the fruit at each step in marketing. The crop of 1948 was considered more normal than that of the previous season when the weather at harvest time was hot and dry.

Various kinds of containers were used in picking and handling the apples. Some boxes used for hauling the apples from orchards to storages were padded with corrugated cardboard pads on the bottom and others on the bottom and sides of the boxes. Apples packed "slack" in a box bruised more than those tightly packed when hauled from the orchard to the storage and from the packing room to the market. More experimental work is needed on the transportation of apples by truck.

Considerable variation occurred in the amount of bruising in picking and handling the fruit in the orchard and in grading, packaging, and transporting to market. Reasonably careful handling during these operations materially reduced the amount of bruising without any material increase in the cost. Some bruising, however, occurred under the most careful handling, especially with the McIntosh variety.

Minor bruising increased in storage due to the weight of apples on each other. There was very little healing over of small bruises, and further deterioration usually occurred with large bruises.

A preliminary report is being prepared covering the various phases of the project.

QUALITY OF FRUIT FOUND IN RETAIL STORES IN MAINE. C. H. Merchant, H. C. Woodward. During the past marketing season the apples offered for sale in retail stores in several Maine markets were examined for bruises and other quality factors such as color, size, and general maturity. It is evident from the large amount of bruising, especially on the McIntosh apples, that improved methods of handling and selling this variety to consumers are most desirable and necessary. Work in this connection will be continued on a much larger scope next year, under a regional marketing project. This study will consider various phases of retailing in an attempt to handle more efficiently the

retailing of apples with a minimum amount of damage and other deterioration to the fruit. The study may include store displays, con-



FIG. 2. Two Methods of Handling McIntosh Apples in Retail Stores.

The upper picture shows a bulk display which permits consumers to handle and select the fruit, resulting in considerable bruising. The lower picture shows the consumer package, cellophane wrapped, which helps maintain quality but increases somewhat the marketing cost.

sumer packages, retailers' margins, price and quality relationships, and other important phases of selling apples.

PREVENTING TISSUE SOFTENING AND BROWNING IN MCINTOSH APPLES. M. E. Highlands, J. S. Getchell. Analyses for calcium content indicated that 1.0 per cent CaCl_2 in solution in contact with the apple slices for 2 hours gave adequate firming but a slight bitter taste when used in preparing pies. New packs of frozen apple slices, prepared in the fall of 1948 using lower limits of calcium chloride (0.1 per cent, .05 per cent, and .025 per cent), are still in storage and will be analyzed this summer.

Sodium bisulphite proved superior to ascorbic acid as a deterrent to browning. As little as 0.05 per cent proved sufficient to block browning for 6 hours after thawing the frozen apple slices.

Vacuum impregnation of apple slices with CaCl_2 solutions was not satisfactory. The use of added pectins, both standard and low methoxy types, was of no value.

It is hoped that a final report on this project can be prepared next winter closing out this project.

DEHYDRATION OF MCINTOSH APPLE SLICES. M. E. Highlands, J. S. Getchell. Exploratory work was done on the treatment of McIntosh apple slices with calcium chloride and sodium bisulphite prior to dehydrating the slices to a moisture content of approximately 12 per cent. This product was excellent in appearance and when reconstituted showed adequate firmness and no discoloration when exposed to the air for 12 hours.

PREPARATION OF APPLE DEXTROSE SYRUP. M. E. Highlands, J. S. Getchell. A few samples of syrup were prepared from fresh McIntosh apple juice by adding 60 per cent solids in the form of dextrose, with some citric acid. These samples were satisfactory from the standpoint of color and brilliance but lacked body. In addition, the acid sugar ratio was such as to affect the flavor unfavorably. Additional work on this project is planned this fall and winter.

BEANS

BREEDING BEANS RESISTANT TO HALO BLIGHT. R. M. Bailey, Donald Folsom. A project is in progress to develop snap, shell, and field beans resistant to halo blight, a disease which has frequently caused serious economic loss in Maine. Segregating populations from crosses of resistant parentage are under study. Unfortunately, due to the dry season, attempts to produce an epidemic of halo blight in the plots were unsuccessful during 1948, but selections based on plant and seed types were made to continue the work.

FIELD BEAN TRIALS. R. M. Bailey. Eighteen yellow eye type bean selections that originated from crosses of anthracnose resistant parentage were compared at Highmoor Farm with two strains of Maine Yellow Eye. Several yielded as well and were found to mature a week earlier. Comparative anthracnose and blight resistance could not be ascertained last season because of dry weather but several have exhibited greater resistance than Yellow Eye in previous trials.

WEED CONTROL IN BEANS. A. E. Prince, Robert Littlefield. Tender-green beans were treated for pre-emergence weeding on the sixth day after planting when the seeds were just starting to sprout. A 2,4-D sodium salt at a rate of $\frac{1}{2}$ pound of 2,4-D acid per acre controlled weeds but caused some malformed stunted plants with distorted leaves and reduced root systems. Although the plants tended to grow out of the injury, many of the beans when harvested were twisted, curled or otherwise distorted, making them unsatisfactory for market.

The beans treated with dinitro, Sinox W, at a rate of 1 gallon of the 13 per cent concentrate per acre, showed little if any injury throughout the growing period, and the yield was nearly three times that from the untreated, uncultivated plots. A single treatment with a dinitro herbicide a few days after planting might well reduce the number of cultivations necessary, as well as much of the hand hoeing if the predominant weeds are susceptible to these chemicals. Injury will result if spraying is done after the beans begin to emerge from the ground.

BLUEBERRIES

The research program on blueberries is being expanded as a result of action taken by the Maine legislature during 1945. Legislation provided for the purchase of land and most of the cost of erecting the buildings and buying the equipment now available at Blueberry Hill Farm in Jonesboro. An industry tax of about $5\frac{1}{2}$ cents per bushel provides producer support for an enlarged program of research and extension work. Cooperation in developing this program is given by a blueberry advisory committee of seven men representing the industry. The income received from the 1948 crop for research purposes during 1948-49 was \$18,000. This was supplemented by about \$9,000 from other experiment station funds in conducting the blueberry research program summarized in this section.

CHEMICAL WEED CONTROL IN BLUEBERRIES. A. E. Prince, W. Buck. Of the several 2,4-D materials used in 1946 and 1947, the five showing the best results were selected for further study in 1948 and one additional material was tried. The materials used were sodium, morpholine, ammonium, triethanolamine and isopropanolamine salts and ethyl ester

formulations of 2,4-D. The main reason for using these various materials was to find one that would kill the weeds, but do a minimum amount of damage to the blueberries. The triethanolamine salt material³ seemed to meet this requirement when used at a concentration of 2000 parts per million 2,4-D acid and applied until the leaves were wet, but not soaking so that an excess ran off onto the ground. Of the other 2,4-D materials, the monohydrate sodium salt is probably the safest to use. The time to spray is the year of the burn when the first leaves are fully formed. Equipment used has been a three gallon, cylinder type, pressure sprayer with either a fan or a cone nozzle which delivers the spray material evenly. Wheelbarrow and tractor-driven sprayers are being developed.

Red maple sprouts, which are not killed by 2,4-D materials, were treated at Blueberry Hill Farm with ammonium sulfamate at a concentration of one pound per gallon. Results of spraying this material in 1947 only on the maple leaves were not satisfactory. In 1948 the root crowns as well as the leaves were treated. During the following

³ The product used was Stantox 66 which is not being manufactured in 1949.

FIG. 3. Farm Buildings Constructed at Blueberry Hill Farm to Provide a Home for the Farm Superintendent and Laboratory and Storage Facilities for Use by the Research Staff.



spring only a few weak sprouts started which presumably can be killed by a second application.

Phenyl mercuri acetate was used in preliminary trials on grasses without satisfactory results. In addition, sodium arsenite was used in treating brake ferns. Observations in 1949 will determine whether this latter treatment was satisfactory.

The following is a list of weeds given according to their relative susceptibility to 2,4-D materials:

Will Be Killed. Alder, white birch, gray birch, pin cherry, sweet fern, pussy willow, prairie willow, narrow-leaved willow, witherod, sumac, hawkweed, dogbane.

Probably Not Killed. Service berry, sugar plum, chokeberry, bush honeysuckle, sheep-laurel, mountain holly, small tooth aspen, large tooth aspen, rhodora, Bebb willow, mountain ash, meadowsweet, hardhack, poison ivy.

Will Not Be Killed. Red maple, bunchberry, bayberry, brake fern, wild rose, swamp dewberry, blackberry, raspberry, cinquefoil, winter-green, grasses.

BLUEBERRY FRUIT FLY. F. H. Lathrop, D. M. Tuttle, B. E. Plummer, Jr. At Blueberry Hill Farm, Jonesboro, the blueberry fruit flies began emerging in the experimental cages about five days earlier in 1948 than they did in 1947, and emergence continued to be a few days earlier throughout the emergence period of 1948.

During the summer of 1948, six different dust mixtures were tested in comparison with the standard blueberry fruit fly dust mixture. The standard mixture consisted of 50-10-40, calcium arsenate, monohydrated copper sulphate, and hydrated lime. Each dust mixture was applied to two plots of 5 or 6 acres of blueberry land, with two applications of 6 pounds of dust being made per acre.

When monohydrated zinc sulphate was used in place of the monohydrated copper sulphate in the standard 50-10-40 dust mixture, there was a significant increase in the amount of injury to the blueberry foliage. When half of the monohydrated copper sulphate was replaced by an equal quantity of monohydrated zinc sulphate, the injury to the blueberry foliage was about the same as with the standard mixture. There appeared to be no material difference in fruit fly control, regardless of whether monohydrated copper sulphate, or monohydrated zinc sulphate, or half of each was in the dust mixture.

A dust mixture composed of calcium arsenate, zinc dimethyl dithiocarbamate and talc (50-7-43) appeared to be slightly more effective than the standard mixture in the control of the fruit flies, but the severe injury to the blueberry foliage makes it unwise to use this prod-

uct. A dust mixture of Cal-Zinc,⁴ Safe-N-Lead,⁵ and hydrated lime (50-8.5-41.5) caused no more injury and possibly slightly less injury to the blueberry foliage, and gave approximately the same degree of fruit fly control as the standard mixture. Basic copper arsenate and talc (16-84) dust caused very slight if any injury to the blueberry foliage, but, compared to the standard mixture, appeared to be slightly less effective for fruit fly control. Rotenone-Pyrenone⁶ dust caused no evident injury to the blueberry plants and for fruit fly control appeared to be as effective as the standard blueberry fruit fly dust mixture. The Rotenone-Pyrenone dust cannot be recommended until more thorough tests can be made, but this mixture seems worthy of further investigation.

BLUEBERRY THRIPS. F. H. Lathrop. During the early spring of 1949, tests at Northport and Appleton were made of chlordan, DDT, and parathion for the control of blueberry thrips. One application was made on May 3, just as the blueberry blossom buds were separating in the clusters. A second application was made on May 6, when the blossom buds were well separated in the clusters, and shortly before the blossoms began to open. No evidence of thrips injury was apparent at the time the treatments were applied.

The results were observed after the thrips injury was well developed on the blueberry plants. DDT concentrate spray, 1 pound of 50 per cent wettable powder per gallon of water, applied by means of a wheelbarrow type, mist sprayer, apparently resulted in practically complete protection of the blueberry plants from thrips injury. Parathion, 1 pound of 15 per cent wettable powder per gallon of water, apparently was equally as effective as the DDT spray. DDT, 5 per cent dust, applied with a crank-type hand duster, apparently reduced the thrips injury but did not protect the plants completely from thrips. Chlordan, as a 5 per cent dust or as 1 pound of 40 per cent wettable powder per gallon of water, apparently was less effective than either DDT or parathion.

Plots that received only one application appeared to have as satisfactory control of blueberry thrips as those that received two applications.

DISEASE CONTROL. A. E. Prince, Donald Folsom, Marilyn Noyes. In a field where twig blight and leaf diseases resulted in almost no

⁴ Cal-Zinc (The Sherwin-Williams Co.) contained 70% tri-calcium arsenate and approximately 3% metallic zinc.

⁵ Safe-N-Lead (The Sherwin-Williams Co.) consisted of a zinc reacted hydrated lime, containing the equivalent of approximately 25% metallic zinc.

⁶ T-316 Rotenone-Pyrenone Dust (Hort.) (U. S. Industrial Chemicals, Inc.) contained 0.25% Rotenone, 0.5% Piperonyl cyclonene, and 0.05% Pyrethrins.

blueberries during the previous year, quarter acre plots were dusted to control diseases, and yields were taken. All of the dusts were applied twice according to the schedule given in Maine Extension Circular No. 255, with the first application made when 95 per cent of the blossoms had fallen and again 12 days later. The materials and amounts used were as follows:

Material	Lbs. Dust Per Acre Per Appli- cation
20% tribasic copper sulphate	20
20-20-60, calcium arsenate, monohydrated copper sulphate, hydrated lime	50
6% zinc dithane	20
10% fermate	15
33% yellow cuprocide	20
20% basi-cop	25

Three applications of Fermate also were made on one series of plots with the extra application made when blossom buds were just opening. This early application did not injure the flowers or the bees which pollinate them. Plots receiving the 3 applications of Fermate and the Tribasic copper sulphate gave higher yields than the plots which were dusted with the 20-20-60 material. The 20-20-60 dust also gave somewhat higher yields than the undusted check plots, but none of these differences in yield were statistically significant.

Extensive collections were made of blighted twigs, a disease which seems to have become more prevalent in recent years. A fungus, *pullularia pullulans*,⁷ that has been isolated from blueberry leaf spots also, was one of the more common of about 15 fungus species found in over 200 isolations.

GROWING BLUEBERRY PLANTS FROM SEEDS. A. E. Prince, J. A. Robinson. A new method has been used to produce blueberry plants from seeds. Seeds were extracted from the fresh ripe fruit of the low sweet blueberry, *Vaccinium angustifolium*, by using a Waring Blendor and repeated washing with water. After cleaning, the seeds were not allowed to dry but were stored moist in the freezing compartment of a refrigerator at about 29° F. The seeds were germinated in Erlenmeyer flasks which contained about an inch of either quartz sand or Terra-Lite⁸ which was saturated with water, covered over with a filter paper

⁷ Identified by Dr. W. Lawrence White, Curator, Farlow Herbarium, Harvard University.

⁸ Terra-Lite, 100% Vermiculite, Universal Zonolite Insulation Co., Pittsburgh, Pennsylvania.

disc, and sterilized in an autoclave to prevent the growth of molds. The seeds were treated with Semesan Jr. and a sample of 25 seeds was placed on the filter paper in each flask under the sterile conditions of a transfer chamber. For germination the flasks with seeds were kept in the greenhouse where the daytime temperature was about 65° F. and at night they were moved to a chamber where the temperature was below 50° F. A count showed that 58 per cent of the seeds on Terra-Lite germinated, producing relatively vigorous plants with good color and excellent root systems, while on sand 20.5 per cent of the seeds germinated, producing much poorer plants.

INCREASING THE STAND OF BLUEBERRY PLANTS. C. W. Hitz. Several methods were found to have practical possibilities, including the use of rhizome cuttings treated with a growth promoting substance, the use of a golf hole cutter for transplanting, and cutting rhizomes in the sod. The results of this work have been published as Bulletin 467, Increasing Plant Stand in Blueberry Fields, by C. W. Hitz, February 1949.

FERTILIZATION OF LOW BUSH BLUEBERRIES. M. F. Trevett, P. N. Carpenter. During 1948 fertilizer experiments already underway were continued and expanded. The phases being investigated include size of fertilizer application, fertilizer ratios, and time of fertilizer application in the cycle from burn to burn. Preliminary experiments also were begun with minor elements.

Data obtained in 1948 apparently confirm the tentative conclusion reached in 1947. About 250-500 pounds of a 7-7-7 fertilizer applied per acre during the year of burn will stimulate growth, producing taller and stronger plants. The same amount of fertilizer per acre during the spring of the first bearing year, applied a week to ten days before the buds open, apparently increases significantly the yield of the second crop, assuming a three-year burn.

ELECTRIC DEER FENCE. Irvin Mason. An electric deer fence was erected at Blueberry Hill Farm during the summer of 1948 in cooperation with the Maine Department of Inland Fisheries and Game. During the winter and spring this has proved to be effective in protecting the plots from deer damage. The fence is relatively inexpensive consisting of only two strands of wire. One strand is four feet high and carries no electrical charge. The lower strand is a fine copper wire electrically charged, placed about 18 inches from the ground on separate posts three feet out from the higher posts. The deer evidently come in contact with this "hot" wire when considering jumping over or crawling under the higher wire. During the spring, when deer tracks showed plainly on the light snow, there was definite evidence that a number of deer attempted to enter the blueberry plots but jumped back when contacting

the wire, returning to the adjoining woods. Additional evidence is needed as to its effectiveness during the summer months.

PROCESSING BLUEBERRIES. M. E. Highlands. Possible sources of a mechanical blueberry stemmer have been investigated. Plans are being made to ship a crate of blueberries to two machinery manufacturers to try on their stemmers this summer.

A canned blueberry pie mix has been prepared and tested by various individuals. While it does not produce a blueberry pie of the type best known to New Englanders, most of the test personnel pronounced it highly acceptable. It is planned to put up an experimental pack in No. 10 cans with a view of obtaining processing data and possibly reactions of the baking trade.

CORN

EUROPEAN CORN BORER.⁹ J. H. Hawkins, A. S. Getchell. The European corn borer caused much injury to sweet corn throughout the State during 1948. Treatment of sweet corn with Ryania, DDT, or Parathion was effective in controlling this insect. Ryania is safe to use on corn that is to be fed to livestock. DDT is cheap and effective and can be used safely from the standpoint of human safety on corn used for market or canning, but DDT should not be used if any part of the corn plants is to be fed to livestock. Parathion can be used on corn intended for feeding livestock if the Parathion is applied at least 30 days before harvest. The chief drawback to the use of Parathion is the immediate danger to the user, because it is a deadly poison and dangerous unless handled carefully.

Three thorough applications of dust or spray applied at about 5-day intervals at the height of the hatching season will give satisfactory control. The insecticide should be concentrated at the bases of the leaves, ears, and in the whorl of the corn plant where the newly hatched borers seek shelter soon after hatching. The borers are not killed when the insecticide is applied after the insects have bored inside the corn stalk.

Moths are reared in cages, and their emergence is used to indicate when the insecticides should be applied. The most effective date usually is about two weeks after peak emergence. During this two-week interval, careful check is made of sweet corn fields to determine when the eggs are being laid so that growers may be warned as to the time to spray or dust.

During 1948, the corn borer problem was complicated by the presence of large numbers of fall armyworms which entered the nearly

⁹Financial assistance was given this project through the Maine Dept. of Agr. from income received from the sweet corn tax.

mature ears. Both Parathion and DDT, although not recommended if corn is to be fed to livestock, are effective in controlling the fall armyworm when the insecticide is applied late in the season after the ears are formed. Fortunately the fall armyworm is not present in large numbers every year, and only occasionally are insecticides necessary for its control.

The experimental work on the control of the corn borer has been summarized from the practical viewpoint of commercial growers in Bulletin 468, European Corn Borer Control, by J. H. Hawkins. March 1949.

SWEET CORN BREEDING AND VARIETY TRIALS.¹⁰ R. M. Bailey, E. F. Murphy. A project to develop better sweet corn hybrids for canning is in progress in cooperation with the Maine Cannery Association. Approximately 1000 plots at Highmoor Farm were devoted last season to the testing of breeding stocks and new hybrids. Several experimental hybrids having Mass. 32 in their parentage were outstanding and their performance suggests that this inbred line may eventually be substituted for P39 in Maine seed production. In a preliminary study of viability of inbreds in cold soil, Mass. 32 was found to be superior among 11 inbreds tested. Hybrids in commercial production as a result of this project and listed in order of maturity season are Early Topcross, Dirigo, Maine Tricross, Hybrid C and Hybrid E. All mature ahead of Golden Cross Bantam. In addition, two early canning hybrids that are recommended for canning are Seneca Golden and Carmelcross.

For home use in northern and eastern Maine, Northland and Sugar and Gold are good first early hybrids. Early Golden 1.13, ripening about 5 days later and Carmelcross, about 10 days later, are excellent to follow. Golden Cross Bantam is recommended for late season in central and southern Maine.

Hybrids suggested for the market grower are Spancross, Early Golden 1.13, Carmelcross, Pilgrim, and Golden Cross Bantam. These ripen from early to late in the order listed.

PALATABILITY OF QUICK-FROZEN SWEET CORN. E. F. Murphy. Samples of six varieties were quick-frozen on the cob within 3 to 4 hours after harvest. After 4 to 6 months' storage, the varieties were tested for quality, by 10 to 15 people on 4 occasions, being rated according to preference. No significant difference was found between Northland, Sugar and Gold, Early Golden 1.13, Fairbo, Dorinny, and Banting as regards palatability. Therefore the choice of these varieties for freezing may be determined by qualities other than palatability. Banting

¹⁰ Financial assistance was given this project through a grant from the Maine Cannery Assn.

developed an unattractive dark color, whereas the other varieties retained their attractive yellow color. Banting and Dorinny are small-eared varieties while Fairbo is a midget corn, and the other three varieties produced larger ears. The small-eared varieties have little loss in trimming, and 3 to 5 ears may be packed in a 10-ounce carton, whereas only 2 trimmed ears of the larger varieties may be packed in the same space. On the other hand, in a favorable season the large-eared varieties give better yields and the loss in trimming may be justified.

There is a tendency among some home processors to believe that vegetables retain a more natural flavor if they are not blanched before freezing. One package of each corn variety was frozen unblanched and tested with the other blanched varieties. Although the unblanched corn was attractive in appearance, the unpleasant flavor was so pronounced as to cause rejection of the samples. Therefore in the case of corn-on-the-cob, blanching is absolutely necessary to obtain an acceptable product.

VITAMIN A VALUES OF MAINE-GROWN SWEET CORN. E. F. Murphy. Four samples of each variety of blanched and unblanched frozen sweet corn were analyzed for B-carotene and kryptoxanthol (vitamin A). Fairbo (containing 0.640 carotene¹¹) and Northland (.459) were superior to the others (.401 to .322) in carotene. Fairbo (.938), Early Golden 1.13 (.915) and Northland (.911) were significantly higher than Banting (.632) and Dorinny (.568) in kryptoxanthol. The blanched quick-frozen, stored samples were significantly higher in vitamin content than the unblanched.

FIELD AND SILAGE CORN VARIETY TRIALS. R. M. Bailey, B. E. Plummer, Jr. Extensive trials of different varieties were conducted during 1948. The results substantiate the conclusions presented in last year's progress report.

WEED CONTROL IN CORN. A. E. Prince, Robert Littlefield. The 2,4-D ester materials are more likely to cause injury than salt formulations. Dinitro materials, like Sinox W and Dow Selective, when used according to manufacturers' directions are probably more safe than 2,4-D materials. From other States it is known that varieties of corn differ as to their susceptibility to the 2,4-D materials, and from experiments at Highmoor Farm the stage of growth within varieties also seems to be a factor. The pre-emergence stage, before the corn comes up, probably is the safest time to treat corn with chemical herbicides. The corn also may be safely treated after becoming 15 to 18 inches tall if the chemical is kept out of the whorls of the corn plants. Moist soil is probably to be preferred to dry conditions. The lower limit of safety

¹¹ The vitamin content is expressed as micrograms of carotene or kryptoxanthol per gram of corn.

for low gallonage and low pressure equipment is believed to be 20 to 25 gallons per acre at 60 to 80 pounds pressure.

Poor weed control may result from poor coverage of the weeds with the chemical, from rain soon after application, or from weeds resistant to the chemical. The 2,4-D esters, being in oil, do not wash off by rain as badly as the salt formulations. Weeds that are killed in the seedling stage include mustards, kale, wild radish, lamb's quarters, red-root pigweed, sow thistle, wild buckwheat, and annual field bindweed. In general, the grasses are not controlled by 2,4-D or dinitro, but annual grasses like foxtail and barnyard grass may be controlled if treatment comes just as the seeds are germinating. Nearly all weeds are resistant when they reach the bud or flower stage. Late treatment, however, may reduce weed seed formation or the viability of the weed seeds produced.

Northern nut grass is a very serious weed because cultivation favors its development and spread. Heavy dosages of 2,4-D material will reduce the stand of nut grass and the number of nuts produced and will decrease the viability of the seeds. The 2,4-D should be sprayed on the nut grass plants at the rate of at least 10 pounds of 2,4-D acid per acre after the ground has been well broken and sprouts are about an inch tall. This procedure should be repeated two or three times during the growing season and continued in following years until eradication is complete.

DAIRY

INHERITANCE IN DAIRY CATTLE. H. W. Hall, H. C. Dickey. Complete information concerning the milk production of bull's dams and their dams' daughters as measures of a bull's transmission of milk production to his daughters was made. Results show that one, or more daughter's records averaged with the dam's record give only slightly more reliability than the dam's record alone. The results of these investigations show conclusively that the dam's record alone or the dam's record averaged with the daughters' records are not reliable criteria of the transmitting ability of the dam's male offspring.

A comparison of various methods used in evaluating the transmitting ability of a herd bull has been published as Bulletin 461, *Selecting a Dairy Bull*, by H. W. Hall, H. C. Dickey, and A. O. Shaw, November 1948.

Intensive investigations also were made during the past year of the use of cow families in the Guernsey breed for the selection of dairy sires. The cow families studies have been limited to the three generations of cows in direct line of descent on the maternal side of the pedigree together with all daughters of these three cows. These cow families are

made up of from two to fourteen individuals. Results show that a cow family composed of from two to five individuals gives no better indication of an offspring's transmitting ability than does the dam alone. Neither the dam's record nor the average records of small families of cows are reliable indicators of what a male offspring's transmitting ability will be. However, when the size of the cow family from which a bull is descended is increased to from five to nine members inclusive, the cow family becomes considerably more reliable as a measure of the bull's inherent ability to transmit high or low milk production. Much more remains to be learned concerning the use of the cow family's milk producing ability in evaluating the milk production inheritance of male offspring.

USE OF THE FOUR PER CENT FAT CORRECTED MILK PEDIGREE IN SELECTING THE DAIRY HERD SIRE. H. C. Dickey. A study is being made to determine the reliability of predicting the transmitting ability of 799 proved Holstein sires, whose sires are proven and whose dams have one or more milk production records. All records of production are computed to a 4 per cent fat corrected milk yield basis as well as to a 305-day, mature equivalent, twice daily milking basis. These F.C.M. pedigree values were predicted by formula and then correlated with the actual production records of the sires' daughters. The predicted production of the son's daughters was computed by using the average of the equal-parent index of the son's sire plus the son's dam's record, and then averaging this with the records of the cows with which the son was mated.

Although this method over-estimated the production of the son's daughters by an average of 836 pounds of milk, yet it estimated two-thirds of all the predictions within 1336 pounds of the actual milk production. In fact, 95 per cent of the predictions were within 2623 pounds of the actual milk production of each son's daughter. Since it was found that this prediction method underestimated the low producers and overestimated the high producers, more refinements in this method are being contemplated.

REDUCING LOSS OF BUTTERFAT IN COMPOSITE SAMPLES. L. M. Dorsey. Mercuric chloride, the preservative commonly used in composite milk samples, completely prevents deterioration due to bacterial fermentation. This preservative, however, does not inhibit milk lipase enzymes which hydrolyse the butyric ester of milk fat and cause a decrease in butterfat test. Losses ranged from 0.042 to 0.143 per cent for 15-day composite milk samples from the University dairy herd.

In the case of individual milk samples, the greater part of the decrease in test, due to fat hydrolysis, occurs during the first 48 hours the

sample is held. The overnight decrease, however, in butterfat test of untreated milk samples from P.M. milking is not over 0.05 per cent and is less for over one-half of the cows. Consequently the sample of afternoon milk may be combined with that for the morning milk, as in D.H.I.A. testing, without serious error. The majority of such tests, when compared with their fresh milk average tests, usually will fall within the 0.1 per cent limit which is incurred when reading butterfat tests to the nearest tenth under.

Invariably the P.M. milk of a herd has undergone some lipolysis by the next morning when the milk is delivered to the receiving plant. Each new sample of the P.M. and A.M. milk mixture, added to the composite bottle, evidently undergoes a slight loss in butterfat test during the next 48 hours.

Acetophenone, in concentrations of about 0.5 per cent by weight, completely inhibits such lipase enzyme activity and also is an excellent preservative against bacterial growth. This product may be substituted in place of mercuric chloride as a preservative in composite milk samples and will prevent any decrease in butterfat test or any increase in acidity.

INFLUENCE OF THE FEED FED TO DAIRY COWS ON THE SYNTHESIS OF THIAMINE AND RIBOFLAVIN. H. C. Dickey, B. E. Plummer, Jr., A. S. Getchell. The possible synthesis of thiamine and riboflavin in the bovine rumen was observed using a Hereford steer with a rumen fistula. The rations consisted of various combinations of timothy hay, mixed timothy and ladino clover hay, corn meal, and soybean oil meal. The thiamine content of the soybean oil meal, as fed, was 51 ppm as compared with differences of only 1.26 to 3.35 for the other feeds. The riboflavin content varied only from 2.0 to 7.7 ppm for these various feeds as fed.

The feeding results indicate little or no synthesis of thiamine in the bovine rumen; or if synthesis did occur the thiamine was removed from the rumen within 10 hours following feeding. On the other hand there is considerable synthesis of riboflavin by the microflora and microfauna in the bovine rumen.

VALUE OF DEHYDRATED POTATOES AS CONCENTRATE FEED FOR DAIRY CATTLE. G. M. Ward, B. E. Plummer, Jr. The value of dehydrated potatoes was compared with yellow hominy feed in the dairy cow ration fed two groups of five Holstein cows each. The chemical analysis showed the dried potatoes to contain 9.2 per cent moisture, 8.4 per cent protein, 0.33 per cent fat, 2 per cent fiber, 13.8 per cent ash, and 66.3 per cent N.F.E. The experimental ration contained about 18 per cent dehydrated potatoes in place of hominy feed, and had a 15.0 per cent protein content which was slightly lower than the regular ration. Both groups of cows were fed hay and grass silage.

After a 30-day feeding trial, the two groups of cows were shifted over to the opposite ration, using a 5-day transition period. Trials were conducted on this alternating basis for three 30-day periods. In analyzing the results it was assumed that the average milk production of the first and last period would equal the second period. By statistical analysis it was found that there was no significant difference in the milk production on the two rations. The fat test variations on the two rations were no different than those ordinarily encountered.

The ration containing the dehydrated potatoes was found to be somewhat unpalatable but by gradually increasing the amount of potatoes in the ration during the five day transition period it was possible to get all of the cows to eat the full amount and none of them showed any signs of going off feed after once getting on to the full amount. The average production of the ten cows for the three feeding trials was 50 pounds of milk with a 3.4 per cent test.

As ground corn and hominy feed have practically the same feeding value for dairy cattle, it would seem that dehydrated potatoes can replace 400 pounds of corn or hominy per ton of dairy feed. There may be a little trouble in getting the cows accustomed to the feed. Also carotene or Vitamine A which is fairly high in corn and hominy will be lacking in the potatoes. However, good quality hay will furnish more than enough carotene. Availability and relative cost seem to be the only factors limiting the use of this feed.

CONSUMPTION OF DAIRY PRODUCTS, PORTLAND MARKET. H. A. Luke. This project was started a year ago as part of the regional research work in dairy marketing. The information included interviews with consumers, excerpts of dealers' sales records, Milk Control Board reports, and related information from other sources. The statistical analysis of these data is now complete and a manuscript has been prepared for publication.

The study has brought to light considerable new information regarding the use of dairy products. It has also served to bring up to date and to expand a similar study made in the Portland Market before the war. The results will be useful in analyzing the problems of maintaining markets, pricing dairy products, and improving efficiency of milk marketing.

RELATIONSHIP OF MARKET SUPPLY AREAS AND PRICES. H. A. Luke. This study was also undertaken as a coordinated project with several other states in the northeastern area. Preliminary assembly of data was begun last fall. In Maine the primary objective of the study has been to determine the actual outline of milksheds within the state, and to analyze the relationships of these milksheds to each other with regard

to competitive supply and price relationships, transportation costs, and the like. Unjustified price differentials between markets or unequal volumes of surplus milk are disturbing both to producers and to the market.

Data has been assembled from the Maine Milk Control Board and from the Boston Market Administrator regarding locations of producers, prices paid, volumes of milk produced, producer transfers between markets, and the like. Information from other sources is being assembled for studying market requirements, transportation costs, and other related considerations.

REGIONAL STUDY OF SEASONAL MILK PRODUCTION. H. A. Luke, W. E. Pullen. An overall project to study the economic aspects of the problems associated with seasonal milk supplies was initiated last year by the Bureau of Agricultural Economics, U.S.D.A. in cooperation with the Boston Market Administrator and the agricultural experiment stations of Vermont, New Hampshire, and Maine. A preliminary report on the marketing phase of this study was reviewed by the cooperating agencies in Boston during March. It contains an analysis of trends in the seasonality of production in the various parts of the milkshed based on information available in the office of the Boston Market Administrator.

The Maine station is cooperating more actively in a second phase of the project which consists of a study of the seasonal production adjustments and opportunities of different producers. Data for this analysis were obtained through interviewing 142 farmers in Maine, 54 in New Hampshire, and 311 in Vermont. These interviews were conducted during the summer of 1948, and the information obtained was correlated with production data from the Market Administrator's office.

The records from the three states were brought together at Orono last fall for tabulation and analysis. A substantial part of the tabulation of the data has now been completed. A preliminary report has been prepared and submitted to the cooperating groups for their appraisal and criticism.

SEASONAL PRODUCTION DATA BASED ON MAINE FARM MANAGEMENT STUDIES, 1928-43. G. F. Dow. A manuscript based on information for approximately 1,000 dairy farm records obtained in Maine over a period of years will be completed this summer. This report includes trends in supply and demand and other factors affecting seasonal milk production. Special emphasis is given to the effect of season of freshening, breeding problems, feed conditions during the pasture season and barn feeding period, and the operation of various price plans on seasonal milk production.

Of special interest may be the analysis of seasonal breeding efficiency for a large number of herds based on artificial breeding records for Maine, New Hampshire, New York, and Pennsylvania. These show, in all states, that breeding efficiency for cows served in the fall and early winter months is slightly better than for those bred in the spring and early summer months. In Maine, the best results were obtained in October, and were relatively favorable in November, December, and January. The lowest efficiency in Maine was in April and May, and in some other states extended into June or July.

The effect of seasonal production on producers' costs and returns also was analyzed. Although production costs are much lower on pasture than during the winter period, the annual cost *per cow* was not affected by season of freshening. The cows freshening during the fall and early winter months had increased milk production per cow, which resulted in a lower cost *per cwt. of milk*.

CONTROL OF BRUCELLOSIS BY CALFHOOD VACCINATION. J. F. Witter. Calfhood vaccination is more complicated than is often assumed because some of the vaccinated animals do not become negative to the test or do not stay negative after entering the milking herd. The records for the vaccinated herds in Maine that are on the eradication program (Plan B) show that 11 per cent of the vaccinated animals were not negative on their last blood test. A similar study of 50 infected herds in the "C" plan showed that 21 per cent of the vaccinated animals failed to become negative. In 92 per cent of 37 "C" plan herds included in a later study, there was one or more "problem" cows which did not become negative within 18 months following vaccination. Of the milk samples from these problem cows, that were tested by inoculation into guinea pigs, 4 out of 14 completed tests were found to contain *Brucella* organisms. This proves that properly vaccinated calves that do not become negative or stay negative to the blood test can and do spread the *Brucella* organism in their milk and are a source of infection of Brucellosis.

FORAGE CROPS

MOW DRYING OF HAY. H. C. Dickey, C. H. Moran, B. E. Plummer, Jr., A. S. Getchell. Two lots of Hereford steers were fed mow-dried and field-cured hay during a wintering period of 182 days. The steers receiving the mow-dried hay gained an average of 168 pounds in body weight during the wintering period, while the steers receiving the field-dried hay gained an average of 188 pounds. Each steer received an average of 22.5 pounds of hay and 1.5 pounds of grain daily. Using prices of \$25 per ton for hay and \$60 per ton for grain, the feed cost

for steers fed mow-dried hay was \$35.24 per cwt. of gain as compared with \$31.63 for steers fed field-dried hay. From these results the field-dried hay produced greater gain at lower cost than the mow-dried hay.

Since mow-dried hay retains more carotene than field-dried hay, a feeding trial is now being conducted using dairy heifers to compare the effect of the additional carotene on growth. Instead of using mow-dried hay, the hay is dried in a Martin haymaker and compared with similar hay which was field cured.

PASTURES FOR BEEF CATTLE. C. H. Moran, H. C. Dickey. Eight Hereford steers were grazed as two-year-olds on an improved pasture at Highmoor Farm. Their average weight per steer was 747 pounds when turned to pasture on May 15, and 839 pounds on August 16. These weights show the average steer gained 92 pounds in 93 days or practically one pound daily. The steers made good gains during this period because the pasture grew well as a result of a moderate amount of rainfall.

An extreme drought during the late summer and fall severely stunted pasture growth. As a result the steers had an average weight by October 29 of only 35 pounds in 74 days, or slightly less than 0.5 pound daily. The weight gains of these two-year-old steers show that these older steers do not make as rapid daily gains on pasture as do younger yearling steers. Better results can be obtained by marketing the steers as yearlings rather than as two-year-old steers.

VITAMIN CONTENT OF MAINE GROWN GRASSES AND LEGUMES. B. E. Plummer, Jr., A. S. Getchell. A study was made of the loss of carotene in 64 dehydrated samples of 13 different varieties of grasses and legumes harvested in 1947 and held in storage for one year. One-half of each sample was blanched with live steam before drying. A portion of each sample was held at approximately 32° F. and the other portion held at room temperature of 75° to 85° F. The samples were kept in tightly closed glass jars and held in the dark.

The samples held at a low temperature lost a small amount of carotene (average about 17 per cent) while those held at room temperature lost most of the carotene (about 87 per cent). There was considerable difference in the amount of carotene lost by different varieties. There was little difference in the average loss of blanched and unblanched samples.

The legumes contained approximately double the amount of riboflavin as the grasses and somewhat more thiamin. Both the riboflavin and thiamin content decrease as the plant becomes more mature. This decrease is greatest in the later stages of maturity. All of the samples

that were harvested as late as August were very low in both thiamin and riboflavin.

The average thiamin content of the thirty-two unblanched samples was 4.14 ppm and the average riboflavin content was 12.84 ppm. Blanching had little effect on the thiamin content, but reduced the average riboflavin content 9.2 per cent.

SOIL FERTILITY AND SOIL MOISTURE RELATIONS IN GRASSLANDS. C. H. Moran, J. S. Hardesty,¹² S. Von Day,¹² R. R. Robinson.¹³ A study to determine the relationship of the chemical and physical properties of the soil to the maintenance of desirable stands of grasses and legumes has been initiated with the cooperation of the Soil Conservation Service and the Bureau of Plant Science, Industry and Agricultural Engineering, U.S.D.A. A section of the central Maine dairy area including parts of Penobscot, Somerset, and Kennebec Counties has been selected for the work. A representative number of farms in the area will be surveyed in 1949 to determine the level of fertility and the moisture capacities of the various soil types.

MANAGEMENT PRACTICES AS THEY AFFECT THE PRODUCTIVITY AND PERSISTENCE OF MIXTURES OF LADINO CLOVER AND GRASS. C. H. Moran, H. C. Dickey, W. C. Libby. Duplicate areas have been seeded on the Rogers Farm in Stillwater to mixtures of ladino clover with brome grass, with timothy, and with Reed Canary grass. For the present the two management systems to be used are (1) cut early as hay or silage, and graze the aftermath; (2) rotationally graze all season.

TESTING FORAGE PLANT VARIETIES AND HYBRIDS. C. H. Moran. A forage crop nursery has been established at Orono, with the first plantings made in the spring of 1949. This will be used to test the Maine conditions from the standpoint of yield and persistence under various systems of management.

FORESTRY

INCREASED PRODUCTION OF NORTHERN WHITE PINE IN MAINE. R. I. Ashman, F. K. Beyer, Gregory Baker, F. E. Holt, G. L. Chapman. Some plantations measured in 1938 have been remeasured. Additional plantings have been measured and trees tallied by size classes and quality, with damage by injurious agencies noted. Injury by the white pine weevil continues to be serious and it is apparent that planters of white pine wishing to grow straight sawlogs must spend some time in weevil control. Permanent sample plots were established in young pine stands

¹² Cooperative personnel of Soil Conservation Service.

¹³ Cooperative personnel of Bur. of Plant Science, Industry and Agr. Engineering, U. S. Dept. Agr.

on the University Forest in which release cutting, thinning, and pruning were carried on. Development of a thinned 18-year-old stand in Liberty and a 35-year-old stand in Chelsea is very satisfactory. There has been little increase in growth on residual trees in a partial cutting made in a middle-aged stand on the University Forest in 1946.

ARTIFICIAL REPRODUCTION. H. A. Plummer, A. L. Prince. Small coniferous seedlings were dug up near roads on the University Forest and taken to the State Nursery where they were transplanted. The cost f.o.b. Nursery was approximately \$3.00 per thousand. Survival of this stock when transplanted was approximately 90 per cent. This is a practicable procedure when there are shortages of tree seeds.

ARTIFICIAL PRUNING. R. I. Ashman, G. L. Chapman, R. F. Taylor. The method of procedure for this project has been changed. Pruning is now being practiced only on red (Norway) pine and one year old branches instead of buds are being removed. This reduces expense and assures the development of the tree if the leader is killed or damaged.

SPRUCE BUDWORM. C. O. Dirks.¹⁴ Assistance was given during 1948 to studies relating to the natural control of the spruce budworm in

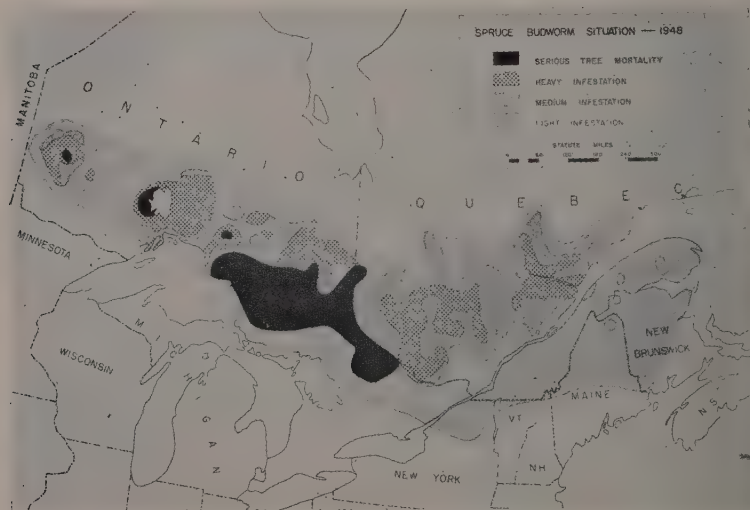


FIG. 4. Spruce Budworm Infestation Has Increased Rapidly Since 1945 in Northern Maine and in the Province of Quebec.

¹⁴ Supervision of research upon the spruce budworm is directed by the Division of Forest Insect Investigations, Bureau of Entomology and Plant Quarantine, U.S.D.A. R. C. Brown, H. J. MacAloney and P. B. Dowden, New Haven, Connecticut, are the administrators of the different phases of the work.

northern Maine. A light to medium infestation developed over a wide area in the northern part of the state (see figure 4). A heavy infestation occurs only 100 miles from northern Maine in the Province of Quebec, north of the St. Lawrence River. Temporary study plots were selected in Ashland, Castle Hill, Garfield, Township 11 R9, DeBouille Mt. area, and near Cross Lake.

All of the common parasites of the spruce budworm that were found in the Adirondacks during 1946 and 1947 were also found to be present in Maine during 1948. The mortality of the budworm caused by the different parasites was light last summer in Maine compared to the heavy mortality during the two previous summers in the Adirondacks of New York. A greatly increased mortality is highly probable in 1949 due to a likely higher infestation of the budworm, and to the wide distribution of the parasites now present. Birds also were an important natural enemy, destroying many of the budworms in 4 of the 5 study areas.

Not only has the spruce budworm infestation increased in Maine during the last few years, but the same is true for the black headed budworm. The black headed budworm was more numerous during 1948 than the spruce budworm and only at the Cross Lake study plot was the reverse true. The black headed budworm is a smaller insect than the spruce budworm and consumes less foliage per individual. Judging from observations made during past outbreaks of this insect in New Brunswick, mature stands of balsam fir are subject to serious feeding. On white spruce, all the new growth may be lost during outbreaks but old needles are not touched and the buds are not killed. Red and black spruce are only lightly fed upon by the black headed budworm.

SEASONING OF MAINE WOODS. Gregory Baker, F. K. Beyer. In 1947 a project was started in Dixfield, Maine, to determine the effect on the rate of air seasoning of four different methods of piling turnery squares. Four piles were erected in each of the months of July, September, and December, 1947, and in April and May, 1948. Moisture content determinations were made periodically with an electric moisture meter on 30 sample bars distributed through each pile. These piles were torn down when fully air seasoned and final accurate moisture content determinations made. Analysis of the data and correlation of these data with weather conditions prevailing during the drying period is currently underway.

The small experimental fan dry kiln owned by the U. S. Forest Products Laboratory has been used principally this past year in working out drying schedules for small partially machined wood products. Experimental work was completed on tube spool bases of green wood

of white and gray birch. Two comparative runs were also made on bases made from black and tupelo gum from Georgia. This material being of irregular form was bulk piled in a wire crib. An apparently satisfactory drying schedule was worked out for both species. The stack after drying was returned to the factory of origin and is to be run through the final machining, finishing and inspection. The results of this factory test will be incorporated in the final data.

One plant in the State, concerned with the manufacture and kiln drying of Brazilian rosewood knife handle blocks requested assistance in determining a good drying schedule for a specified size of block— $1\frac{1}{8}'' \times 1\frac{1}{8}''$ square by 5" long. Four test runs were made with this stock using increasingly severe drying conditions. Some of the blocks were bulk piled in the wire crib while others were systematically stacked. In one run half of the stock was end coated with filled hardened gloss oil. Preliminary inspection indicates that a schedule with an initial temperature of 140° F. and an initial relative humidity of 89 per cent which increases in severity to a final temperature of 170° F. and a final humidity of 28 per cent, gave the best results. The basis of inspection was the number and severity of end checks. This material is being held in storage pending the installation of a machine at the factory for final shaping and finishing. The amount of cull, based on seasoning defects, will be the final criterion for judging the effectiveness of the various schedules.

SERVICE LIFE OF MAINE WOODS FOR POSTS. Gregory Baker. Work on this project continued this year with the installation of 50 Norway pine posts which were derived from thinnings in a plantation on the University Forest. Starting in the summer of 1949, an annual inspection will be made of each post. A measured pull with a spring balance will be applied to the top of each post to test for failure.

STAIN AND DECAY PREVENTION IN BIRCH TURNING BOLTS. M. T. Hilborn. The data for this project has been completed and are being assembled for publication. The project was conducted in cooperation with the U. S. Forest Service and the Division of Forest Pathology, Madison, Wisconsin.

TREE VOLUME AND BOARD FOOT-CORD RATIO TABLES. F. K. Beyer, H. A. Plummer. Some measurements were taken of large white pine trees on Indian Township, Washington County, in March. Additional measurements will be made in plupwood cuttings on the same area during the summer. Insufficient data are available to permit publication of tables.

MARKETS FOR FOREST PRODUCTS. Gregory Baker, F. E. Holt, R. I. Ashman. In traveling through the State new industries are noted but

no extensive data are collected. Price lists of forest products for various markets are kept up to date:

GRAIN

SMALL GRAIN TRIALS. C. H. Moran. Tests of a selected group of wheat, oat, and barley varieties were made in cooperation with the Division of Cereal Crops and Diseases, U.S.D.A. at Highmoor and Aroostook Farms. For the first time all oat varieties tested at Aroostook Farm were found to be infected with stem rust. Similar reports have been made by other states but the disease has not yet reached serious proportions. The results of the 1948 trials have been published as Mimeographed Report No. 1, 1948 Small Grain Trials, November 1948.

WEED CONTROL IN OATS. A. E. Prince, Robert Littlefield. Three 2,4-D materials and a dinitro product were used in weed control experiments at Highmoor Farm in Ajax oats that had been seeded with clover. The oats were treated at four stages of growth, namely the 4 to 6 inch, 6 to 8 inch, flower and milk stages. The 2,4-D materials were used at a standard concentration of $\frac{1}{2}$ pound 2,4-D acid per acre, while the dinitro was used at a concentration of 1 gallon of the 13 per cent concentrate per acre. All materials were applied at a standard rate of 100 gallons of water per acre.

The 4 to 8 inch stage seems to be the best time of application because the weeds are more susceptible to the action of the herbicides. The weeds controlled include the mustard, kale, wild radish, lamb's quarters, redroot pigweed, wild buckwheat and the annual field bindweed.

The dinitro product, Sinox W, did not injure either the oats or the clover when applied in the 6 to 8 inch stage.

The 2,4-D sodium salt monohydrate is preferred over a sodium salt because it goes into solution more easily. This material did not injure the oats but caused slight injury to the clover. The triethanolamine salt reduced the viability of the grains, and killed the clover. The isopropyl ester reduced the growth of the oats, especially in the 4 to 6 inch stage, reduced the yield and the viability of the grains.

HOGS

IMPORTANCE OF EFFICIENT RATIONS FOR SWINE. H. W. Hall. Three dry-lot pigs were fed a balanced ration containing 15 per cent *dehydrated* alfalfa meal, with a protein supplement of soybean meal, which is a plant protein. Two other dry-lot pigs were fed a ration containing 15 per cent *dehydrated* alfalfa meal with a protein supplement of animal

origin, meat and bone meal. Both of these two lots of pigs exhibited symptoms of rickets after they had been on feed for 8 weeks. Evidently the *dehydrated* alfalfa meal did not supply sufficient Vitamin D to prevent rickets. Fortified cod-liver oil was added to both rations and a marked recovery was manifested within one week. Including 0.50 to 1.00 per cent cod-liver oil or 0.125 to 0.25 per cent fortified cod-liver oil is good insurance in the ration of dry-lot pigs. Direct sunlight and irradiated yeast are other good sources of Vitamin D, but these supplements do not contain any Vitamin A. Maine Concentrate Fish Meal is a satisfactory source of both Vitamins A and D.

Two pigs each from litters born in April and in May were selected, and placed on pasture when they weighed an average of 125 pounds. The pigs which were born in April were placed on pasture on June 24; those born in May were placed on pasture on July 5. The earlier born pigs utilized the pasture to greater advantage, and required less grain per 100 pounds of gain than did the later born pigs.

HOME ECONOMICS

DIETS AND NUTRITIONAL STATUS OF JUNIOR HIGH SCHOOL PUPILS.

Mary M. Clayton, Dorothy E. Ullman, Prudence S. Higgins. This project is part of a regional nutrition study which is being carried out in cooperation with the Experiment Stations in Massachusetts, New Jersey, New York, Rhode Island, and West Virginia. In the spring of 1948 physical examinations for nutritional defects were given to 450 Bangor Junior High School children by Dr. Wilbur B. Manter, Bangor physician. The children also kept diet records for four days and had blood tests for hemoglobin, carotene, and vitamins A and C.

The following types of defects were prevalent: underweight; signs of previous rickets; rough, dry "goose pimply" skin (probably related to deficiencies in vitamins A and C and carotene); reddened, peeling lips and cracks and sores at the corners of the mouth (related to a deficiency of the B vitamins, especially riboflavin); changes in the surface of the tongue (probably caused by a deficiency of some of the B vitamins); inflamed gums (in most cases associated with a deficiency of vitamin C) and decay of the teeth. Underweight, reddened peeling lips and inflamed gums were seen more often in the boys than in the girls.

The results of the blood test indicated that the most outstanding deficiencies were in carotene and vitamin C. The boys were apt to be lower in these constituents than the girls.

The four-day diet records, in addition to the physical examinations and blood tests, showed the diets to be low in the green and yellow fruits and vegetables which are good sources of carotene, and in the foods high

in vitamin C such as citrus fruits, tomatoes, and raw cabbage. Insufficient milk also was used in the diets of about half of the children. Many of the diets contained a proportionately high amount of sweet foods, such as cookies, cake, doughnuts, pie, ice cream, candy, and soft drinks. These foods are high in calories, but are deficient in the vitamins in which the diets as a whole were low.

Detailed calculations of the average amounts of various nutrients contained in approximately 140 of the children's diets showed that the most common deficiencies were in calories, iron, vitamin C and niacin. Niacin is one of the B vitamins, contained in enriched bread and whole grain cereals, dried beans and peas, lean meats, fish, poultry, peanuts, potatoes, milk, and green, leafy vegetables. The most outstanding dietary deficiency was in vitamin C.

FIG. 5. Junior High School students at a Bangor school receiving a hot lunch including meat, vegetables, bread, butter, milk, and dessert.



The hot school lunches tended to be low in the same nutrients which were low in the diets as a whole, but they usually supplied adequate protein, calcium and vitamin A. A deficiency of vitamin C was especially evident. Also the lunches were apt to be low in calories for the larger boys who have a very high food requirement. The box lunches which the children brought from home were usually low in vitamins A and C, but as a group the children who ate them had better home meals than those who ate the hot lunch. Children who ate lunch at the corner store fared the worst of all. Their diets were low in all nutrients. In general more of the children who ate the hot school lunch had good daily diets than those who ate other types of lunches.

During the spring of 1949 a study was made of 332 junior high school children in Skowhegan, Bucksport, and Newport. The results for these towns have not yet been summarized but the children showed the same types of nutritional defects as were seen in the Bangor group.

COMPARISON OF DIFFERENT MODELS AND SIZES OF KITCHEN SINKS. Merna M. Monroe. Additional information indicates that it is easier for women to work at sinks that are 6 inches deep than at those 8 inches deep. This conclusion is based on posture measurements of the women while they worked at four cardboard sinks with different design or placement. Two of the sinks had 6-inch-deep basins; one of these was placed with the rim at the customary height of 36 inches from the floor, the other with the rim 38 inches from the floor. The other two sinks had 8-inch-deep basins with the rims of both placed 36 inches from the floor; one of these sinks had a 1½-inch wide rim while the other had a 3-inch-wide rim between the worker and the basin.

Most of the women who were over five feet three inches tall preferred the 6-inch-deep sink with the rim placed 38 inches from the floor. At the 8-inch-deep sinks the women complained of muscle strain across the shoulders, at the small of the back, and at the back of their legs. Most of the women commented on feeling still greater muscle strain when working at the sinks which had the 3-inch-wide rim.

KINDS OF WORKING AND STORAGE SPACES NEEDED IN MAINE RURAL HOUSES. Merna M. Monroe. For functional planning of houses it is necessary to know what kinds of activities the family carries on in various rooms. Rural homes having one or more children two to nineteen years old were surveyed to learn the rooms now used for children's play and for other family activities and the homemaker's preferences in respect to what rooms she would like to use for these activities. Inventories were taken of children's toys and play equipment. The information will be summarized this coming year.

The above study supplements a detailed survey made in the spring of 1948 as part of a cooperative northeastern regional project of farm-



FIG. 6. Most women, except those who are very short, prefer the sink at the left which has a 6-inch-deep basin, a $1\frac{1}{2}$ inch wide rim, and the rim and counter placed 36 or 38 inches from the floor. The sink at the right, which is 8 inches deep, with a 3 inch rim, and is 36 inches from the floor, caused muscle strain.

home needs and preferences. Regional funds were allocated to Cornell University to analyze the data and write the report for this cooperative study.

PEAS FOR PROCESSING

FERTILIZER, LIMING AND SEEDING RATE TESTS AT PRESQUE ISLE.
G. L. Terman, S. C. Junkins. As was true in 1947, drilling ground limestone down the spout with the pea seed on an acid soil at Aroostook Farm produced the largest increase in yield of shelled peas of any treatment tested. Where 400 pounds of limestone was applied per acre on soil having a pH of 5.1-5.3, the average yield of Thomas Laxton peas was 3,600 pounds of shelled peas. Omitting the limestone cut the yield 940 pounds. On adjacent plots previously limed to pH 5.4-6.0, omitting the limestone decreased the yield by 490 pounds. Applications of fertilizer did not increase yields in this experiment.

In 3 other experiments at Aroostook Farm application of 450 pounds of 10-10-10 fertilizer resulted in an average yield of 3,980 pounds of shelled peas per acre, as compared to a decrease of 700 pounds where fertilizer was not applied. Omitting nitrogen cut the yield by 550 pounds, omitting potash cut it by 500 pounds, and omitting phosphorus resulted in no loss in yield.

Seeding Thomas Laxton peas at the 3-bushel rate yielded 2,600 pounds of shelled peas per acre. Seeding 4 bushels per acre increased the yield to 4,100 pounds. Seeding 5 bushels resulted in no appreciable further increase in yield.

When the row spacing of drilled peas was increased from 7 to 14 inches, the yield per acre decreased 56 per cent. A further increase in row spacing to 21 inches, decreased the yield 70 per cent below that for the 7-inch spacing.

Increase in yield and tenderometer readings of shelled peas over a 4-day period was determined on plots in a fertilizer experiment. For plots not fertilized with nitrogen the yield increased only 310 pounds for the period of August 2-5, while tenderometer readings increased from 95 to 138. On plots fertilized with 45 pounds of nitrogen per acre the yield increased 1,015 pounds, while tenderometer readings increased from 89 to 124. Thus nitrogen tends to increase yields while keeping the peas tender over a longer period of time.

FERTILIZER TESTS IN CENTRAL MAINE. M. F. Trevett, H. J. Murphy. Fertilizer tests, made in cooperation with H. C. Baxter and Brother, Hartland, Maine, show the importance of nitrogen fertilizers in maintaining high quality during the period when peas are making large daily gains in yield. The 1948 results indicate that on a moderately to highly fertile soil the requirements of peas can be met by the use of a nitrogen fertilizer alone. On a relatively infertile soil a fertilizer containing nitrogen, phosphorus, and potassium appears essential for an optimum yield.

WEED CONTROL IN PEAS. A. E. Prince, Robert Littlefield. The dinitro products, Dow Selective, Sinox W and Sinox, were used in Thomas Laxton peas in the 2 to 4 leaf stage at one-half, one, and one and one-half times the dosage recommended by the manufacturer.

Weed control was not entirely satisfactory at the lower concentration, while there was some indication of injury to the peas at 1½ times the recommended rate, especially with Sinox W. Weed control was exceptionally good where the materials were applied at the proper rate under ideal conditions. Because Sinox is more difficult to mix there is little to recommend its use when Sinox W or Dow Selective materials are available.

POTATOES

Special recognition should be given to the support of the potato industry which has made possible the present enlarged potato research program. About \$56,000 was allotted by the Potato Tax Committee for research work during 1948-49. This represented approximately one-third of the total amount budgeted by the committee from all income derived from the potato tax of one cent per barrel. These research funds assisted in financing the following projects, which are included in this summary of all potato research work conducted by the Experiment Station:

- Methods of Controlling Ring Rot.
- Soil Fertility in Central Maine.
- Potato Variety Trials.
- Development of Leafroll-Resistant Varieties.
- Development of Strains of Seed Potatoes That Are Free of Latent Mosaic and Certain Other Tuber-Borne Diseases.
- Control of Aphids Through Use of Insecticides.
- Weeds and Other Secondary Host Plants as a Source of Aphid Infestation to Potatoes.
- Relation of Aphid Population and Leafroll Content of the Seed to the Spread of Leafroll During the Summer.
- Potato Top Killing and Chemical Control of Weeds in Potato Fields.
- Engineering Studies Including New Potato Storage House and Potato Combine.
- Storage, Grading and Packaging Maine Potatoes.
- Potato Products Including the Use of Starch Plant Waste.

CHEMICAL WEED CONTROL IN POTATOES.¹⁵ P. J. Eastman, James West. Pre-emergence applications of 1 or 2 pounds of 2,4-D acid equivalent per acre satisfactorily controlled broad leaf weeds, such as mustard and kale, where cultivation was eliminated. However, rates as low as one-half pound of 2,4-D acid equivalent per acre, applied in 1948 as a sodium salt, anine salt, or butyl ester, caused marked distortion of potato plants. This distortion occurred with Katahdin, Sebago, Green Mountain, Cobbler, and Chippewa potatoes, irrespective of time of application, either pre-emergence or after the plants were up. The results for 1948 indicate that no 2,4-D material should be used in or near seed potato fields, for this distortion of the plants resembles leaf roll or certain types of mosaic and makes roguing for disease practically impossible.

¹⁵ Financial assistance was given this project through a grant from the Sherwin Williams Co.



FIG. 7. Katahdin Leaves Showing Typical Distortions Produced from Foliage Applications of 2,4-D Materials. The Leaf at the Bottom is Normal.

Sinox W, a dinitro herbicide, applied as a pre-emergence spray at the rates of 1, 2, and 3 quarts per 100 gallons of water gave excellent control of broad leaf weeds at the two higher rates. No damage was done to the potato plants by any of the rates except for the highest rate which caused severe burning of the foliage of plants that were above the ground. Apparently this product is satisfactory if applied as a pre-emergence spray.

This experimental work during the summer of 1948 indicated that certain chemicals may be a partial substitute for ordinary cultivation and hilling practices in the control of most broad leaf weeds in potatoes. Annual and perennial grasses, however, were not controlled. Thirty-five per cent of the tubers from uncultivated strips were severely sunburned, while only 10 to 15 per cent of the tubers in the normally cultivated and ridged plots showed this type of injury. Slightly higher yields were obtained from plots where normal cultural practices were carried on than on plots treated with 2,4-D and cultivated and hilled only once.

MANAGEMENT OF JAPANESE MILLET AS GREEN MANURE FOR POTATOES

TOES. S. C. Junkins, G. L. Terman, Michael Goven. The average yield of dry matter over the period of 1943-48 from millet not fertilized with nitrogen was 3,120 pounds per acre, as compared with 6,270 pounds when 50 pounds of nitrogen was applied at planting time. Very little additional increase was obtained from 100 pounds of nitrogen. Over the same period the yield of dry matter from unfertilized crimson clover was 3,130 pounds.

Mowing millet before it was knee-high increased the yield of dry matter slightly, as compared to unmowed millet. Mowing also retarded the formation of seed, which matures in some years and creates a weed problem in the potato crop which follows.

Plowing millet before frost in early September while still green as compared to plowing after potato harvest in late October resulted in no difference in the yield of the following crop of potatoes.

In a comparison of seeding rates for millet of 15, 25, 35, and 45 pounds per acre, yields of dry matter increased up to the 35 pound rate. As frequently is the case with small grains, more stems per plant developed at the lighter seeding rates, making the stand nearly as dense as at the heavier seeding rates.

BROADCAST NITROGEN APPLICATION FOR POTATOES. G. L. Terman. In an experiment at Aroostook Farm on potatoes following millet, a broadcast application of 50 pounds of nitrogen from cyanamid or ammonium nitrate in the fall or in the spring, or 100 pounds from ammonium nitrate broadcast in the spring failed to increase yields over those obtained with 2000 pounds of 5-9-9 (100 pounds nitrogen) alone.

In a second experiment at Aroostook Farm the 5-year average increase in yield of potatoes following millet in a 2-year rotation has been 21 bushels for 50 pounds and 34 bushels for 100 pounds of nitrogen applied broadcast for the potato crop, as compared to the row fertilizer alone containing 100 pounds of nitrogen per acre. On adjacent plots cropped every year to potatoes the average increase for broadcast applications of 50 or 100 pounds of nitrogen in addition to the row fertilizer has been only 17 bushels. Both of the above experiments were located on rather level, fertile land.

At 2 locations in Central Maine, broadcast applications of nitrogen have failed to increase yields of potatoes over the 2000-2200 pounds of 5-10-10 applied at planting in both 1947 and 1948. Broadcast treatments in these experiments included 50 pounds of nitrogen from cyanamid and 50 and 100 pounds from ammonium nitrate or ammonium sulfate. Certain of these treatments were compared both on plots of potatoes following a potato crop and on plots following green manure.

SOURCE OF NITROGEN FOR POTATOES. G. L. Terman and S. C. Junkins. Ureaform, a recently developed nitrogen material, was com-

pared as a source of nitrogen fertilizer for Katahdin potatoes in a field test at Aroostook Farm. All plots were fertilized with 2000 pounds of 5-9-9 in row side-bands per acre. Yields obtained with ureaform as the sole source of nitrogen averaged 92 bushels less than the average yield for 3 common sources, urea, ammonium nitrate and ammonium sulfate, which gave similar yields. These results indicate that ureaform is not a satisfactory source of nitrogen for potatoes.

The highest yield of 507 bushels per acre in this test was obtained with fertilizer containing one-half of the nitrogen content as ammonium nitrate and one-half as ammonium sulfate. This combination supplies one-fourth of the nitrogen in the form of nitrate and three-fourths in the ammonium form.

EFFECT OF RATE OF FERTILIZATION OF POTATOES WITH NITROGEN AND POTASH. G. L. Terman, S. C. Junkins, Michael Goven. Field experiments were conducted at four locations in 1948 to determine the effect on potato yields of applying in row side-bands 2000 pounds of fertilizer per acre containing different rates of nitrogen and potash, but a uniform rate of 180 pounds phosphoric acid equivalent (9 per cent P_2O_5).

In only 1 experiment out of 6 did the 240 pound rate of potash (12 per cent K_2O) result in a significantly higher yield of the Katahdin variety than where the 180 pound rate (9 per cent K_2O) was applied. The average increase in this 1 experiment was only 22 bushels per acre. These results are similar to those obtained previously.

The response to nitrogen fertilizer and previous cropping, as indicated by average acre yields of potatoes was as follows (bushels):

Crop in 1947	90 pounds N (4½% N)	120 pounds N (6% N)	150 pounds N (7½% N)
Potatoes	509	532	562
Green manure	563	583	596

There was a greater yield response to nitrogen following a potato crop than following a green manure crop, and there was a higher yield level following green manure. Significant increases in yield for 150 versus 120 pounds of nitrogen resulted in 2 tests with the Katahdin variety and in 1 test with the Green Mountain variety following a crop of potatoes. Where Green Mountains followed green manure, a slight decrease in yield was obtained with the largest application of nitrogen. These results in general confirm those obtained in 1947, indicating the possible response of the Katahdin and similar varieties to more than 150 pounds of nitrogen in the fertilizer per acre on intensively cropped land.

PHOSPHORUS RATE AND PLACEMENT FOR POTATOES.¹⁶ G. L. Terman, S. C. Junkins, Michael Goven. Rate and placement of ordinary pulverized superphosphate and of granulated superphosphate were studied in an experiment with Katahdin potatoes on soil low in available phosphorus at Aroostook Farm. Nitrogen and potash were applied in row side-bands at a uniform rate of 2000 pounds of 6-0-9 per acre.

At a rate of application of superphosphate equivalent to 80 pounds P_2O_5 per acre, average yields of 408 and 347 bushels, respectively, were obtained for the pulverized and granulated material applied in row side-bands. Placing either the pulverized or granulated material at the same rate with the potato seedpieces resulted in marked decreases in yield, probably because of injury to the seedpieces by the superphosphate. Applying pulverized superphosphate in row side-bands, the standard method, at the rate of 160 pounds P_2O_5 resulted in an average yield of 434 bushels. Applying the same amount of granulated material one-half in row side-bands and one-half with the seedpieces resulted in an average decrease of 61 bushels, as compared to the standard method.

EFFECT OF POTASH SOURCE ON YIELD AND STARCH CONTENT OF POTATO TUBERS. G. L. Terman, S. C. Junkins. An average significant increase of 21 bushels per acre was obtained for sulfate over chloride or muriate in one test with Katahdins. In 5 other tests with Katahdins and 2 tests with Green Mountains, there were slight yield differences in favor of the chloride source. These results are in agreement with those obtained in previous years indicating no appreciable or consistent yield differences between these sources of potash. The same has been true for combinations of chloride and sulfate or of potassium metaphosphate and nitrate sources of potash. The source of potash has not been found to have any consistent effect upon the need of potatoes for nitrogen fertilizer.

Starch content of the tubers, as estimated from specific gravity determinations, was again higher in 1948 for sulfate, as compared to the chloride source of potash. For the Katahdin variety the starch content of tubers produced with sulfate averaged about 1 per cent higher, and Green Mountain tubers were nearly 2 per cent higher in starch than where the chloride source was used.

EFFECT OF POTASH SOURCE IN FERTILIZER ON NUTRIENT AND DRY MATTER CONTENT OF POTATO RACHISES. P. N. Carpenter, Harry Trask. Fertilizer containing chloride as a source of potash, as compared to sulphate, reduced the starch content of Green Mountain and Katahdin tubers, reduced the dry matter content of the rachises, and resulted in a marked increase in both the chloride and potassium content of the

¹⁶ Financial assistance was given this project through a grant from the Summers Fertilizer Company.

rachises. Increasing the rate of application of potash as the chloride also tended to increase the chloride and potassium contents, but did not appreciably affect the content of total nitrogen, phosphorus and magnesium. Differences in nutrient and dry matter content had no significant effect on yield.

COMPARISON OF RAPID TISSUE TESTS WITH QUANTITATIVE METHODS FOR DETERMINING NUTRIENT CONTENT OF POTATO RACHISES. P. N. Carpenter. A high degree of correlation was obtained between the results of analyses of green potato rachises by rapid methods as compared to analyses of dried tissue by quantitative methods. The correlation coefficients obtained were: nitrate nitrogen by rapid methods and total nitrogen, 0.96; soluble phosphorus and total phosphorus, 0.82; soluble potassium and total potassium, 0.72; and soluble calcium and total calcium, 0.73. Apparently reasonably reliable results can be obtained by rapid colorimetric methods without using the more time consuming quantitative chemical methods.

SOIL CONDITIONS AFFECTING POTATO SCAB. G. L. Terman, P. N. Carpenter, Harry Trask. Thirty-five per cent of the samples of scabby soils from 20 areas in central and southern Aroostook were from shallow soils on ledgy knolls or slopes usually underlain by limy rocks; 30 per cent were from poorly drained depression or seep areas usually dark in color and high in organic matter. The soils from these conditions varied in pH from 5.2 to 5.9 and were medium to very high in exchangeable calcium. Twenty per cent of the samples were sandy or gravelly soils, where scab occurred at pH values as low as 4.8 and the calcium content was very low to low. Fifteen per cent of the samples were from unusual conditions such as near farmyards or where stable manure had been piled.

In this preliminary survey, no evidence was found that proper liming at recommended rates had increased the potato scab problem. The high lime content of soils in ledgy, depression, or seep areas and uneven application of lime seem to be the most frequent causes of scab. Dust from limy road gravel is a contributing cause of frequent occurrence of scab immediately adjacent to many roads.

The results of soil conditions and treatments for potato scab, obtained during 1935-47, have been published as Bulletin 463, Effects of Certain Soil Conditions and Treatments Upon Potato Yields and the Development and Control of Potato Scab, by G. L. Terman, F. H. Steinmetz, and Arthur Hawkins, December 1948.

POTATO SOIL FERTILITY STUDIES IN CENTRAL MAINE. G. L. Terman. Yields were low in 1948 because of drought conditions in August, particularly at Unity. Possibly because of lack of moisture, potato yields were slightly lower in a 2-year rotation with millet or legume green manure

crops, than following potatoes on the continuous cropping plots. At Unity heavy rains following planting caused rotting of the seedpieces on some of the continuous cropping plots to the extent that replanting was necessary. Little rotting occurred on adjacent plots where green manure was plowed down the previous fall.

In the portion of the experiments where different soil pH levels are being established to study development of potato scab, certain plots have been limed to about pH 6. Although there was considerable scab on certain areas at Unity and some at Milo, the scab was no more severe on plots limed in 1947 and 1948 than on plots not limed recently. Similar results were obtained at Exeter in 1947. Certain soil conditions apparently existing prior to the start of the experiments in 1946 or 1947 influenced scab much more than did recent liming.

IRRIGATION OF POTATOES. R. A. Struchtemeyer, W. C. Libby. The 1948 yields obtained from Chippewas in Corinna were 167.4 barrels for the irrigated plots and 104.6 barrels for the non-irrigated plots. This meant an increase of 62.8 barrels or a 60 per cent yield increase in favor of irrigation. In East Corinth the yield of Katahdins for the irrigated plots was 114.5 barrels as compared to only 67.4 barrels for the non-irrigated plots. This increased yield of 47.1 barrels represents a 69.9 per cent increase in favor of irrigation. The overall lower yields at East Corinth were due to varietal differences and generally poor cultural practices.

At both locations it was apparent that about 150 pounds of nitrogen, 200 pounds of potash and 200 pounds of phosphoric acid were adequate quantities of the major nutrients irrespective of whether or not the potatoes were irrigated. These tests were made on loam soils with a medium fertility level.

SOIL CONSERVATION PRACTICES. J. W. Slosser.¹⁷ An experimental farm at Fort Fairfield, including 59 acres of cropland with an 8 to 18 per cent slope, has been operated since 1940, under soil conservation practices. These practices have included contour planting throughout, cropland terraces on areas with a slope of around 12 per cent, and diversion terraces with and without interceptions on the steeper areas with a slope of about 18 per cent. Supplementary practices have included grass waterways and strip cropping.

Prior to 1940 this farm, with relatively steep slopes, had been severely damaged by erosion and overcropping to potatoes. Potato yields were low and the soil was difficult to handle. However, soil and water conservation practices, plus the addition of green manure crops in alternate years, have caused the land to become noticeably more friable and have helped to nearly double potato yields.

¹⁷ Cooperative project with Soil Conservation Service, U. S. Dept. Agr.

Comparable areas under soil conservation practices which have received green manure crops in a two-year rotation produced 172 barrels of potatoes per acre as compared with 95 barrels for areas planted continuously to potatoes since 1940.

Diversion terraces with interceptions resulted in a yield of 125 barrels per acre as compared with 106 barrels on comparable areas without interceptions. This represents an increase of 17.9 per cent or 19 barrels per acre, due largely to the conservation of water by the interceptions on these 18 per cent slopes.

The channels made eight years ago in cropland terracing continue to have a low yield averaging 144 barrels per acre as compared to 169 for the ridges which include the topsoil removed from the channels. The areas below the ridges averaged 162 barrels per acre as compared to 156 barrels for the areas above the channels.

POTATO VARIETY TRIALS. W. C. Libby, G. W. Simpson, Donald Folsom, Reiner Bonde. Eighteen varieties of potatoes were compared as to their yield adaptability and specific gravity at six different Maine locations (Van Buren, Presque Isle, Houlton, Patten, Exeter, and Bethel). The varieties included nine named standard varieties and nine unnamed seedlings. The order of the first ten varieties on yield at all locations was Ontario, Green Mountains, B76-43, Kennebec, Teton, Chippewa, N.D.K-5, B61-3, B294-22 and Mohawk. Insofar as specific gravity was concerned the order for the first ten varieties was B76-43, Green Mountain, B294-22, B61-3, Mohawk, Irish Cobbler, Kennebec, Empire, B301-43, and Teton.

EFFECT OF THIOUREA ON TUBER SIZE.¹⁸ P. J. Eastman, G. L. Terman. Both soaking the seed 1 hour in a 1 per cent thiourea solution and dipping the seed in a 3 per cent solution caused an appreciable increase in the number of stems emerging per hill of potatoes. The average increase in stems per hill for seed piece spacing of 10 inches at Aroostook Farm was from 2.7 to 3.8 for the Katahdin variety and from 4.4 to 4.9 for the Green Mountain variety. In a commercial test in Fort Fairfield on about 2 acres of Katahdin potatoes, with seed treated by dipping in 3 per cent thiourea solution and spaced an average of about 9 inches, the treatment increased the average number of stems per hill from 2.1 to 3.0. Due possibly to unfavorable moisture conditions or other factors, however, the increase in the number of stems was accompanied in both trials by only a slight increase in the yield of tubers of desirable seed size (less than 10 ounces). In 1947, however, an increase in the number of stems resulted both in an increase in the number of tubers set per hill and a material increase in the yield of potatoes of desirable seed size.

¹⁸ Financial assistance was given this project through a grant from Eastern States Farmers' Exchange, Inc.

POTATO VINE KILLING EXPERIMENTS. P. J. Eastman, Michael Gov-
en, B. E. Plummer, Jr. Vines treated in mid-August when they were
actively growing were difficult to kill and tended to produce new growth.
On September 8 when vines were closer to maturity most of the vine
killing materials and methods gave a satisfactory kill. The dinitros, such
as Sinox General and Dow 66 Improved, gave a rapid rate of kill, the
arsenicals an intermediate rate of kill, and cyanamid an intermediate
to slow rate of kill. It was found essential to get thorough coverage of
the vines with all materials to obtain a satisfactory kill. On some of the
later varieties cyanamid did not give a satisfactory kill. The flame
burner gave a rapid kill of leaves but left stems standing which produced
new growth. The rotobeater disintegrated leaves and stems immediately
leaving a stub several inches long which produced new growth unless
treated with a herbicide.

There was some indication that materials resulting in a rapid rate
of kill produced more vascular discoloration in the tubers in 1948 than
those materials that killed the vines at a slower rate. An exception to
this was the rotobeater, which resulted in very little discoloration. Ap-
parently more severe discoloration occurred the nearer to maturity the
plants were killed. This was particularly true of the early varieties,
Chippewa and Cobbler. Some fading of the discoloration was found to
take place prior to digging. However, it was found that the discoloration
did not fade in storage at two different storage temperatures, 36 and 50
degrees, between November and March. Since the discoloration in the

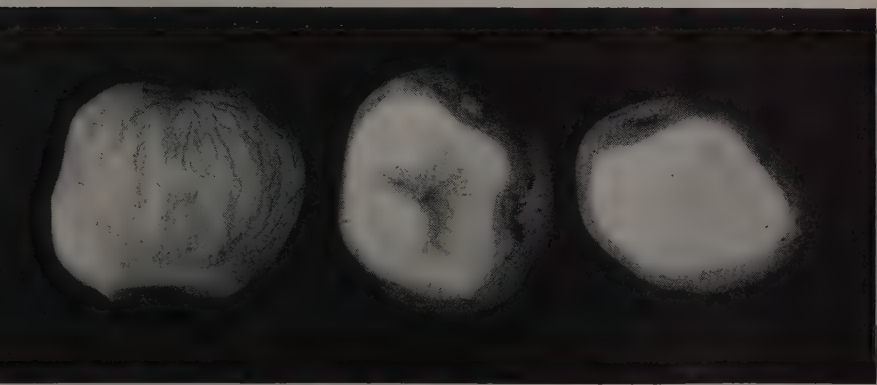


FIG. 8. Vascular Discoloration of Potato Tubers Caused by Top Killing. The tuber on the left has been pared to the vascular ring area. The tubers in the center and on the right have been clipped at the stem end. The one in the center shows discoloration; the one on the right is clear fleshed.

1947 crop was observed to fade under similar storage conditions, it is probable that the same basis of classifying the discoloration was not used by the 2 different individuals examining the 1947 and 1948 samples. A slight yellowing of the vascular ring, which occurs normally under many conditions, was not considered a discoloration in the 1948 samples; only noticeably blackened tubers were classed as discolored. This more severe type of discoloration also was found in fields in which the vines had not been killed; also where the vines were killed by frost. This indicates that factors in addition to vine killing methods and materials are involved.

CONTROL OF LATE BLIGHT BY KILLING POTATO TOPS. E. S. Schultz,¹⁹ Reiner Bonde. The amount of late-blight tuber rot was reduced by macerating infected foliage with a rotobeater and then not harvesting the crop until after the foliage had become dry and dead. Spraying with an herbicide after the foliage had been treated with the rotobeater was helpful in reducing the amount of late-blight tuber rot. The vascular discoloration resulting from killing the potato foliage with Sinox or sulphuric acid did not reduce the yielding ability of Green Mountain seed potatoes.

SPRAYING AND DUSTING EXPERIMENTS.²⁰ Reiner Bonde, J. A. Robinson, B. E. Plummer, Jr. Four new liquid dithiocarbamates controlled late blight satisfactorily in 1948 with higher yields than occurred with standard Bordeaux and basic copper sulphate. The new fungicides copper phthalate, dicyclopentamethylene thiuram disulfide, and benzothiazole disulfide (thiofide), did not control late blight satisfactorily. Copper nitrodithioacetate was superior to zinc nitrodithioacetate for the control of late blight and for high yields. Neither was equal to Bordeaux and tribasic copper sulphate in these respects, both were compatible with DDT, and the yield rate was increased by combining them. The yield rate was increased significantly by 7 widely approved fungicides, the least by Bordeaux and the most by Zerlate which, however, did not give satisfactory control of late blight. C-O-C-S (copper oxychloride sulphate), copper zinc chromate, Dithane D-14, Dithane Z-78 and Parzate allowed good yields and controlled the blight.

The yield rate under Bordeaux, basic copper sulphate, and Dithane, when applied with a tractor-mounted sprayer, was 142, 145, and 146 barrels per acre respectively without DDT and 152, 157, and 159 barrels per acre respectively with DDT. With late blight absent, plots sprayed with basic copper sulphate yielded 10.2 barrels or 28 bushels more per acre than did the Bordeaux plots included in the same experiment. DDT as a wettable powder produced higher yields than did DDT as an oil

¹⁹ Cooperative study with Bur. Plant Industry, U. S. Dept. Agr.

²⁰ Financial assistance was given these experiments through grants from General Chemical Co., E. I. du Pont de Nemours Co., and Tennessee Corporation.

emulsion when used with Bordeaux, but not when used with basic copper sulphate. Increasing the lime content of Bordeaux did not increase the number of aphids or reduce the insecticidal value of added DDT, but the addition of lime to Bordeaux or to a basic copper sulphate spray mixture increased defoliation by early blight.

A freshly mixed copper-lime dust fungicide containing DDT controlled both early and late blight better than did the same kind of dust used some time after being prepared. The freshly mixed dust also gave good control of aphids and flea beetle injury, and increased the yield by 13 barrels per acre (36 bushels). In the absence of late blight, the highest yield rates under a Cuprocide-talc and a basic copper sulphate-talc dust were obtained when the applications were made while the foliage was dry and the wind was blowing. Z-78 dust (zinc ethylene bisdithiocarbamate) responded less favorably to the addition of DDT than did basic copper sulphate and Cuprocide.

The injury caused by the tractor wheels of the sprayer rig reduced the yield rate 9 barrels per acre or 6.2 per cent of the crop. The loss to the crop from injury caused by a tractor-mounted duster outfit was 14.3 barrels per acre or 6.4 per cent of the crop. Fields dusted with the helicopter gave an increase in yield of 5 to 12 barrels per acre more than fields dusted or sprayed with tractor-drawn machines. The yield rate and the control of early blight and insect injury tended to be decreased as the concentration of dusts was increased and the pounds of dust applied decreased from 40 to 10 per acre.

EFFECT OF MAHOGANY BROWNING IN SEED STOCKS ON STAND AND YIELD. Reiner Bonde, Donald Merriam. The cold injury in Katahdin and Chippewa seed potatoes known as "mahogany browning" reduced the stand and the yield rate in 1948. Katahdin seed with a trace of the condition yielded 148 barrels per acre compared with 165 barrels for seed which had not been injured. Seed tubers with severe symptoms of mahogany browning yielded 139 barrels per acre, and the stand in the field was reduced from 95 per cent (normal seed) to 78 per cent.

CONTROL OF RING ROT. Reiner Bonde, Donald Merriam. About 400 samples of farmers' seed potatoes were examined for ring rot. About 12,000 tubers were indexed in the greenhouse for ring rot and when healthy were planted by tuber units in the field for increase and distribution to growers.

As equipment disinfectants, Puratized N-5-E, Puratized Agricultural Spray and copper sulphate continued to have promise, while many other tested disinfectants had no value.

Several of the new potato varieties have not taken ring rot for 4 or 5 years when the freshly cut seed pieces were contaminated with ring rot bacteria. Resistant varieties were found less likely to be masked

carriers of the disease than other varieties. A Katahdin seed stock may be infected with ring rot and not show symptoms of the disease until the following season. There was some evidence that bacteria with increased virulence may be produced in the resistant varieties, but such bacteria infected relatively low percentages of plants in the resistant varieties and produced practically no active decay. Some new varieties are resistant to both ring rot and late blight, and some are early maturing.

COMPARISON OF DIFFERENT MILD SEED TREATMENTS. Reiner Bonde, Donald Merriam. Treating seed potatoes has been abandoned by many farmers because the varieties now being grown are easily injured by the standard seed treatment methods. On the other hand, losses from *Rhizoctonia*, blackleg, and seed-piece decay, may be large some seasons. Therefore, there is a need for milder disinfectants which will destroy the surface tuber-borne disease organisms and not injure the seed potatoes. Experiments conducted in 1948 indicate that the mercury-containing materials known as Puratized Agricultural Spray and Puratized 806 may be suitable for the treatment of seed potatoes. Zinc carbamate in a water suspension appeared to possess value for treating cut seed potatoes.

TESTING NEW POTATO VARIETIES FOR FIELD RESISTANCE TO LEAF-ROLL. Donald Folsom. Field spread of leafroll in the Highmoor Farm test plot, with every third row planted leafroll, has been greater in years of early peak aphid infestation than in years when flea beetles or leafhoppers were abundant. In 1947, field spread infected 50 to 84 per cent of different batches of seedlings, some of which had escaped the disease for several years. On the other hand infection occurred in only 4 per cent of a batch of seedlings at Highmoor Farm that had not become leafroll in the Aroostook Farm aphid test. In the aphid test, the number of disease-free seedlings was about doubled by using parents that had shown field resistance. Among the seedlings found resistant are some with good-looking vines and tubers that should be used in making new crosses.

CONTROL OF LATENT MOSAIC. Reiner Bonde, G. W. Simpson, Donald Merriam. About 13,000 tubers were indexed in the greenhouse for freedom of latent mosaic. The healthy tubers were planted by tuber units in the field and the resulting tuber lines will be increased for the Foundation Seed Program.

DETERIORATION AND PHYSICAL BREAKDOWN OF POTATOES IN STORAGE AND TRANSIT.²¹ Donald Folsom, H. Q. Roach.²² The percentage of tubers showing mahogany browning and the percentage of discolored tissue increased in transit for shipments from Maine to New York City

²¹ Cooperative project with Division of Markets, Maine Dept. Agr., and with Bureau of Plant Industry, U. S. Dept. Agr.

²² Cooperative agent of Division of Markets, Maine Dept. Agr.

in April and May 1948. The percentage of tubers affected increased less when stored at 67° than at 47°, and the percentage of discolored tissue not only increased less at 67° than at 36° and 47°, but decreased in New York City 65° storage following transit.

In the 1948 crop, of about 150 Green Mountain bins selected in Aroostook County, 140 were free of net necrosis, only trace amounts were present in several bins, and 3 to 13 per cent were found in 5 bins. Shipments in January from these 5 affected bins showed no significant increase in net necrosis between Maine and New York City.

Stem-end browning was more generally present than net necrosis, but was seldom serious. Of 6 shipments in January, 2 showed significant increases during transit of stem-end browning causing 5 to 10 per cent waste and of stem-end browning causing over 10 per cent waste. These increases ranged from 2 to 4 per cent waste and occurred at medium transit temperature of 43 to 50° F., close to the optimum for the development of stem-end browning. Significant differences of 3 to 5 per cent in stem-end browning causing 5 to 10 per cent waste and in stem-end browning causing over 10 per cent waste, were found between two lots taken from the same bin at different times and stored in Maine in different places for a few days.

Early-blight lesions on Katahdin tubers did not enlarge in transit in February at 49-61° F. but became dried out, less conspicuous, and shallower. Fresh bruise cracks formed on Katahdin tubers during grading in part healed and in part became scorable in transit. Muddy, partly frozen Katahdins that were sawdusted, run over a rubber brusher, and shipped in January or February, lost what percentage of intact tubers they had, and showed highly significant increases in tubers with scorable bruises, scorable lesions, and scorable lesions with soft rot.

APHID CONTROL. *Leafroll Spread and Solvents for DDT.* G. W. Simpson, W. A. Shands,²³ R. M. Cobb, and P. M. Lombard.²⁴ Plots of Green Mountain potatoes that were treated with DDT, in addition to a fungicide, showed an increase in yield of 11% when harvested on September 14. Plots harvested earlier at weekly intervals, beginning August 10, showed no significant increase in yield until August 31. This indicates that DDT as such had no stimulating effect upon the potato plants. Unlike the results from a similar experiment conducted in 1947, the increase in yield for the later harvests came more from an increase in tuber size than from an increase in the number of tubers. There was a definite reduction in leaf roll spread from the use of DDT in these plots in 1948.

²³ Cooperative study with Bur. of Entomology and Plant Quarantine, U. S. Dept. Agr.

²⁴ Cooperative study also with Bur. of Plant Industry, Soils, and Agr. Engineering, U. S. Dept. Agr.

This is the first such result in experiments conducted in Maine. The virtual absence of winged green peach aphids in the area is believed to have contributed to this result. Control of the wingless aphids from the use of DDT was good.

A test of six DDT emulsion sprays containing different solvents for the DDT and applied weekly throughout the season resulted in no injurious effects on foliage of Katahdin potatoes, no significant difference in yield of tubers, and only slight differences in aphid control. These results are similar to those obtained from a similar experiment conducted in 1947.

Other Aphid Control. W. A. Shands,²⁵ G. W. Simpson, R. M. Cobb. Four weekly applications of DDT as a dust or as a spray prior to July 21 resulted in as high a yield of Katahdin potatoes as a total of 12 applications applied weekly up to September 14. Four applications a week apart, started early, were adequate under conditions of little or no reinfestation of the plants by winged aphids. The dust mixture containing 3 per cent DDT and 4 per cent of a relatively nonvolatile oil resulted in better aphid control and larger yields than the DDT spray containing 0.5 pound of DDT per 100 gallons. Yellow cuprous oxide was the fungicide in both dust and spray mixtures. Late blight was not a problem in this experiment.

For aphid control, toxaphene as a wettable powder was equal or superior to DDT wettable powder at the same concentration, and to DDT emulsion at the normal rate. The toxaphene emulsion and the rotenone sprays were less effective. Toxaphene, in the concentrations used in these studies, caused serious foliage injury to Katahdin potatoes, while DDT and rotenone did not.

From relative toxicity studies with aphicides in the field, the residual toxicity of a 10 per cent toxaphene dust was found to be sufficiently great to permit a reduction in concentration. A lower concentration might eliminate foliage injury to Katahdins. There also appears to be considerable possibility of reducing the DDT content of dusts, without impairing aphid control, by adding a nonvolatile oil to the dust mixture or by impregnating a dust diluent with DDT dissolved in an oil. Parathion in a spray mixture was found to be very promising as an aphicide.

APHID BIOLOGY STUDIES. G. W. Simpson, W. A. Shands,²⁵ F. S. Roberts, W. A. Kendall. The winged summer dispersal forms of green peach and potato aphids matured in an average of 16 to 27 days after colonies were started by spring migrant aphids on weeds growing in oats. The winged dispersal forms matured in the first generation in about 70 per cent of the colonies of potato aphids, but were not found until the

²⁵ See footnote 23.

second generation of the green peach aphid. Weeds should be controlled wherever found because winged aphids can develop on them and fly to potatoes.

Unlike results in previous years during early summer, the weeds in a field of English peas were found to be more important as aphid hosts than similar weeds growing in potato fields. Weeds in fields of clover and of oats were less important than usual as aphid hosts. Weeds growing in wasteland, sometimes a very important source of winged aphid for infesting potatoes, were relatively unimportant in 1948.

Leafroll spread in Green Mountain potatoes was directly related both to the number of leafroll plants present and to the numbers of wingless aphids infesting the plants. There was some evidence that Chippewa potatoes may be more tolerant of aphid feeding than Green Mountains.

The total catch of aphids, in the seven traps operated near Presque Isle, was slightly larger in 1948 than in 1947. Buckthorn aphids were the most numerous, followed by the potato aphid and the green peach aphid. The only other year in which there were smaller numbers of flying green peach aphids than of other species was 1943. The largest daily catch of the buckthorn aphid was on August 28, of the green peach aphid on September 7, and of the potato aphid on September 9.

Another feature of the 1948 flight records of interest was the relatively large numbers of spring migrants of the foxglove aphid taken in the traps in 1948. In contrast, no migrants of the green peach aphid were taken this year.

Predators and parasites were especially effective in controlling aphids in 1948. Ladybird beetles and their young were unusually abundant and considerably influenced the aphid populations. Fungus diseases, sometimes so effective in reducing aphid populations, were of only minor importance in 1948.

Caged colonies of the buckthorn, green peach, and potato aphids on their overwintering hosts, produced many more winged forms than similar colonies in previous years. Spring migrants of the foxglove aphid were found near Presque Isle before such forms had matured in natural colonies on foxglove growing locally in a sheltered location. Spring development and migration of the aphids from their overwintering hosts to potatoes and weeds was somewhat earlier in 1948 than in 1947. However peak numbers of aphids on potatoes were reached later in the summer than in the previous year.

Aphid egg surveys in the fall or spring, which provided information on the probable abundance of the aphids, agreed fairly well with the actual early season populations of the buckthorn and green peach aphids. Such was not the case for the potato aphid, probably because the rose is also

used as a primary host by other species of aphids. Eggs of the potato aphid cannot with certainty be distinguished from those of other species of aphids.

EFFECT OF APPLICATIONS AND SOIL RESIDUES OF DDT AND TOXAPHENE ON POTATOES AND OTHER CROPS. W. A. Shands,²⁶ G. W. Simpson, G. L. Terman, A. S. Getchell. DDT and toxaphene were added to the soil in 1948 prior to planting Katahdin potatoes and other crops. The DDT was applied at rates of 15 and 60 pounds of technical DDT per acre respectively. The 15 pound rate was intended to simulate the total quantity of DDT residues that would accumulate after three years of applying DDT for potato insect control in commercial fields. Toxaphene was applied at the rate of 32 pounds of technical toxaphene per acre alone; in combination with DDT at the rate of 32 pounds of technical toxaphene and 60 pounds of technical DDT per acre; and in combination with DDT at the rate of 10 pounds of technical toxaphene and 15 pounds of technical DDT per acre, respectively. None of these applications had a significant effect on the total weight of potatoes and oats produced and no obvious effects on the growth of barley, peas, and medium red clover. However, certain treatments with toxaphene with or without DDT caused a reduction in the number and size of some grades of potatoes.

When toxaphene was applied to the growing Katahdin potato plants in spray concentrations of 1.0 pound of technical grade as emulsion, or 3.2 pounds of technical grade as wettable powder per 100 gallons, there was definite foliage damage following 2 weekly applications. After these 2 applications, these concentrations were reduced to 0.625 and 2 pounds, respectively, for the final 6 applications. These rates appeared to have caused less damage, but the plants did not fully recover. Toxaphene, applied as a wettable powder, caused a significant reduction in total yield, in the yield of U. S. No. 1 potatoes, and also affected the size of tubers.

Plantings for the above experiments were made rather late in the season, which may have affected the results obtained.

No DDT or toxaphene was found in any of the samples of pea vines, pea pods, shelled peas, and potato tubers from the soil-treated plots, or in potato tubers from the plant-treated plots.

FLORIDIA TEST. G. W. Simpson, E. L. Newdick,²⁷ W. F. Porter.²⁷ The number of samples sent to Florida for testing for leafroll and other virus diseases declined from 1,555 in 1947 to 1,285 in 1948. The acreage represented by these samples was reduced from a total of 17,315 in 1947

²⁶ See footnote 23.

²⁷ Cooperative service work with Division of Plant Industry, Maine Dept. Agr.

to 16,124 in 1948. Most of the samples sent represent Katahdin, Chippewa, Irish Cobbler, and Green Mountain.

Since the advent of DDT in 1946, there has been a steady improvement in the quality of the stocks tested. In years past some lots, especially Chippewa, were nearly 100 per cent diseased. In 1948, on the other hand, the highest reading was only 6.9 per cent total virus. Ninety per cent of all lots tested in 1948 were found to have less than 1 per cent total virus and so were listed on the foundation list.

DEVELOPMENT OF POTATO COMBINE. J. W. Slosser,²⁸ L. E. Ward. The recently developed one-row machine was given an extensive field test during the 1948 harvest. It performed very satisfactorily both as to rate of digging and as to quality of potatoes from the standpoint of grade bruising. A crew of five men was used. The rate of digging was 78 barrels or about one-half acre per hour. Grade bruising from the combine averaged slightly less than with standard digging equipment. A few minor changes have been made to this machine since the 1948 harvest, which presumably will further improve its operation.

The one-row machine has a conventional draper chain for elevating the potatoes and separating the dirt. One man, stationed at the rear of the draper, removes the potato tops from a short, cross conveyor as the potatoes pass along to a picking belt where three other members of the crew remove the stones. The potatoes then pass directly into suitable containers. The picking belt is a special flexible, metal mesh, grader chain, with $1\frac{1}{8}$ " square openings. These permit small particles to pass through, thus delivering clean potatoes to the container. The machine derives its power from the tractor through a conventional power shaft.

A two-row combine harvester also has been constructed and tested briefly at Corinna. This machine did not prove satisfactory, partly due to very unfavorable digging conditions caused by dry soil and many weeds, and partly due to mechanical difficulties resulting from wartime substitutions used in construction.

POTATO HARVESTING METHODS IN MAINE. W. E. Schrupf. The cost of harvesting and the amount of bruising of potatoes on Maine farms during the past three years has varied widely due to such factors as type of harvesting equipment and how it is operated, care in picking up potatoes, maturity of potatoes, soil conditions, and yield rate. This study includes work on the potato combines which are in their experimental development. The material for the three-year period has been summarized in manuscript form for a Station bulletin entitled, Practices, Costs, and Tuber Bruising in Digging Potatoes in Aroostook County, Maine.

EXPERIMENTAL POTATO STORAGE HOUSE. H. D. Bartlett. A 15,000

²⁸ Cooperative study with Soil Conservation Service, U. S. Dept. Agr.



FIG. 9. Front View of One-Row Potato Combine Harvester.

Arrangements also have been made for using a bagging attachment in place of barrels. A semi-automatic rotary table with hydraulic barrel lift also has been constructed for removing full potato barrels from the machine.

barrel experimental potato storage house was built at Aroostook Farm during the summer of 1948 to serve as a laboratory for studies in potato handling, grading, packaging, and controlled storage conditions as affecting quality of potatoes.

Post free areas in both the basement and on the ground floor are provided to insure unrestricted space for use of new equipment. This free working space has been made possible by the use of large steel I-beam girders for support of the ground floor, and by the use of laminated arch rafters for the self supporting roof and wall framings. The building is 50 feet by 60 feet with a 14 foot basement and a 16 foot first floor ceiling height. Floor flues (8 inches by 24 inches) were cast in the concrete basement floor to serve as channels for the bin unloader conveyor and to connect the wall air space with the open rollway to provide air circulation around the bins.

During the 1948-49 season, potatoes were handled by means of conveyors both into and out of storage. Spot checks were made to determine the handling rate and per cent of bruising. Tests were also made to determine the effectiveness of various types and amounts of insulation.

STORAGE, STORING, GRADING, AND PACKAGING MAINE POTATOES. C. H. Merchant, J. H. Bragg, W. E. Schrumpf. Information for the past four years has been collected on labor requirements, equipment used, and amount of bruising in storing potatoes in farm and track storage houses. The material will be summarized in a brief preliminary report. Considerable variation existed in the efficiency of storing potatoes as well as wide differences in the amount of bruising occurring to the tubers during the storage.

Much information has been assembled on the size of potato storage houses of various constructions located both on farm and on track. Farm storage houses were surveyed during the summer of 1947 and the track storage houses during the summer of 1948. Potato houses were measured to ascertain the desirable and undesirable features as they may affect the efficiency in storage, taking potatoes out of storage, and space available for grading, packaging, and handling potatoes.

Some additional work has been conducted on a regional inventory of the frost free storage facilities in the important potato producing areas in the Northeast. The material other than that for Maine is fragmentary and it may take one or more years to complete the work by other states.

Information for the past four seasons has been assembled on taking potatoes out of storage. The time was recorded for each method of handling potatoes along with the amount of bruising occurring to the tubers. The results of the four years are partially summarized.

Field work on grading and packaging potatoes is continuing with all types of graders for both wholesale and consumer packages of potatoes. It will be possible to show comparisons of the quality of potatoes shipped under the Marketing Agreement and before. Also, further at-



FIG. 10. New Potato Storage House at Aroostook Farm.

In upper picture note the conveyor at doorway to carry potatoes from truck to bin. The middle picture shows the laminated arch rafters and the post-free area for packing and grading studies. The lower view shows the floor bin system for the bin unloader conveyor in the basement storage.

tention was given again this year to storing packaged potatoes before shipment especially where large quantities of potatoes have been packaged and stored. The problem is a very significant one, especially with Government purchases combined with car shortages.

CONSUMER ACCEPTANCE OF SIZED POTATOES. C. H. Merchant. A report entitled "Consumers' Acceptance of Sized Potatoes" has been published as Station Bulletin 465. It was expected that certain phases of the study on size of tubers would have been continued this year and consideration given to marketing potatoes of various amount of grade defects. However, the Federal Marketing Agreement does not permit selling potatoes under 2¼" or potatoes which do not meet U. S. No. 1 requirements. Consequently additional phases of this study have been postponed until such time as it seems expedient to continue them.

QUALITY OF POTATOES. C. H. Merchant, A. L. Perry, R. J. A. Bouchard, H. C. Woodward. A ten per cent sample of the shipping point inspection certificates for the past three seasons has been tabulated and analyzed. The information shows that cuts and bruises, and sunburn are the most important grade defects in all the potato producing areas of the State. It is planned that this information will form the basis for a manuscript for a Station publication.

The quality of potatoes offered for sale in retail stores in Philadelphia, New York, Boston, and Maine markets has been published in preliminary reports by the Pennsylvania, New York, and Maine Stations. The results of the study by the Maine Station have been published as Bulletin 466, "Quality of Potatoes in Retail Stores in Boston, Massachusetts and Maine Markets, 1948."

A study of the quality of potatoes at Aroostook shipping points and at wholesale and retail markets in Boston, is a phase of the regional study that was carried on cooperatively with the Division of Markets of the Maine Department of Agriculture and Federal inspectors of Production and Marketing Administration. A large number of samples of potatoes were inspected at shipping points and the same samples inspected again in the wholesale and retail markets in Boston. This study was undertaken during February and March of this year to show the quality of potatoes at each of these three important places in the marketing of Maine potatoes and to determine the extent to which the quality of potatoes changed in the marketing process.

WASHING AND DRYING SUPER QUALITY MAINE POTATOES. M. E. Highlands. Katahdin potatoes were washed with plain water and two types of synthetic detergents. Following this they were dried using infra red heat in one instance and hot air in another. It was concluded that washing with added detergents for one minute was as good or better

than washing in plain water for three minutes. The choice of detergent would depend on cost and low foaming characteristics.

Infra red drying, at least under conditions of test, was not satisfactory. Drying in a hot air blast continuous tunnel appears to be the most feasible method. Potatoes should be absolutely dry before packaging.

RECOVERY OF AMINO ACIDS FROM STARCH PLANT WASTE LIQUID.

M. E. Highlands. A small laboratory setup was prepared and some samples run to determine the possibility of recovery of amino acids by use of ion exchange resin systems. On the basis of these experiments it was decided that at this time and with the present knowledge that applications of this system to an industrial enterprise would not be feasible. It would appear that the installation costs of such a recovery plant would be far in excess of the benefits derived.

DRYING POTATO STARCH PLANT WASTE FOR LIVESTOCK FEED. M. E. Highlands, M. C. Hutchins, B. E. Plummer, Jr. The Maine Institute of Potato Starch Manufacturers, Inc., provided a building, press, and drying equipment for pilot plant purposes and additional funds for assistance in experimental work. The starch plant waste, after the addition of a minimum of 0.3 per cent lime, is reduced from its initial water content of 94 per cent to about 70 per cent using the Zenith pilot plant press. This 70 per cent moisture press cake is then reduced by drying to a moisture content of 12 per cent. The actual cost per ton of dried pomace can be determined only after drying has been conducted on a larger scale operation.

Standard feed analyses of the dried pomace are indicated below.

Ingredient	Continuous	Continuous	Batch	Batch
	unlimed %	limed %	unlimed %	limed %
Moisture	2.72	5.20	2.46	3.39
Protein	6.47	3.10	8.06	4.96
Fat	.37	.10	.33	.26
Fiber	11.99	10.25	9.05	8.72
Ash	2.65	14.69	3.53	9.83
Nitrogen free extract	75.80	66.66	76.57	72.86

The analyses indicate that this dried product may be a good stock food. Feeding trials have been started with poultry and will be undertaken with dairy cattle. Preliminary experiments also were made during 1948 in feeding dried whole potatoes, the results of which are included under the Dairy and Poultry Sections of this report.

POULTRY

HIGH ENERGY-LOW FIBER RATIONS FOR CHICKENS. R. W. Gerry, J. R. Smyth, C. E. Howes. During the year feeding trials have involved approximately 1,200 chicks, 300 growing pullets, and 72 laying hens.

With Rhode Island Red males, reared to 12 weeks of age, the best growth, feed efficiency and return over feed cost were obtained when the High Energy Connecticut Broiler Ration was fed throughout the experiment. The poorest results were obtained when the birds were shifted at 8 weeks to a regular growing ration. A shift to a lower protein high energy grower gave fairly good results. Significantly poorer results were obtained with a regular starter fed throughout the experiment, or with a shift at 8 weeks from the regular starter to a regular grower.

With Barred Plymouth Rocks, a High Energy ration which was a modification of the Connecticut High Energy ration, produced the best feed efficiency, but growth and return over feed cost were quite similar to that of those fed the regular 1948 New England College Conference rations. From these two trials, it appears that the best results in rearing chicks for meat are obtained from a *good* High Energy ration fed throughout the growing period.

In a third trial, Reds, Rocks and their reciprocal crosses from the Experiment Station strains, these being closely related, were used. One lot of each was fed the regular starter and the other the high energy starter used in Trial II. All groups made greater gains to 12 weeks of age on the high energy ration than on the regular starter, the Rocks being more pronounced in this than the other lots. The feed efficiency for the Barred Rocks and for both crosses (male and females combined) was approximately 3.14 pounds of the regular starter per pound of gain, and 2.87 pounds for the high energy ration. The Reds required 3.31 pounds of the regular starter per pound of gain, and 3.15 pounds of the high energy starter. The feed efficiency for all the males in the experiment combined was 3.00 as compared with 3.14 for the females. The sex linked birds used, made as good or better gains than did the broiler cross birds.

In another trial underway, three lots of 100 Barred Plymouth Rock females each were involved. The growth, feed efficiency, date of maturity and number of eggs laid to date were quite similar for the High Energy ration fed throughout and for the 1948 New England College Conference rations (starter to 10 weeks, grower to 20 weeks and finally the layer).

A total of 72 Barred Rock pullets that were just starting to lay were divided into two groups, one of which was fed the New England

College Conference laying ration and the other a low protein modification of the High Energy Connecticut Broiler Ration. To date the birds fed the High Energy ration have gained an average of 0.6 pound while those on the regular laying ration have not changed appreciably in weight. Those on the High Energy ration have eaten less feed but have laid fewer total eggs than those on the regular ration.

DEHYDRATED POTATOES AS A SUBSTITUTE FOR CORN IN A CHICK RATION. J. R. Smyth, R. W. Gerry, C. E. Howes. Dehydrated potatoes were used to replace 25, 50, 75, and 100 per cent of the corn in a standard starting ration fed in two tests to 225 Rhode Island Red chicks. The starting ration containing 40 per cent of corn was used as a check. The results of the two tests show that the type of dehydrated potato used was not satisfactory as a substitute for corn especially when 50 per cent or more of the corn was replaced.

When chickens were fed dehydrated potatoes free choice with other ingredients of the ration other than corn, the chicks ate practically none of the potato, growth was low and mortality high. The lots receiving a choice between corn and potatoes ate a normal amount of corn and other feeds and grew normally. The cooking of dehydrated potatoes for 15 minutes in an autoclave increased the value of the potatoes but the method used in this test did not make them equal in value to corn in a chick ration.

RELATIVE VALUE OF PELLET AND MASH FEEDING FOR GROWING PULLETS ON LADINO CLOVER RANGE. J. R. Smyth, R. W. Gerry, C. E. Howes. The work this year involved 200 Rhode Island Red Pullets that were put on range at 10 weeks of age and removed to the laying house at 22 weeks of age. During the 12 weeks on range those fed pellets gained 2.64 pounds each as compared to 2.37 pounds each for those fed mash. The pullets fed pellets required 6.9 pounds of feed for each pound of gain as compared to 8.3 pounds for those fed mash. Mortality was very low, and egg production to date has been practically the same in both lots.

LENGTH OF INCUBATION PERIOD IN POULTRY AS RELATED TO CHARACTERISTICS OF PROGENIES. J. R. Smyth, C. E. Howes, R. W. Gerry. The work during the year involved a study of the sex ratio of the 245 chicks hatched in 1948 and the laying house performance of the pullets raised. There was no appreciable difference in the sex ratio between the chicks hatching early and those hatching late. Neither is there any important difference in the egg production of the different groups for the six months they have been laying.

BREEDING FOR SUPERIOR MEAT QUALITY IN POULTRY.²⁹ C. E. Howes, J. R. Smyth, R. W. Gerry. This project is being conducted to determine whether or not a superior meat type bird can be produced without sacrificing egg production. In the production of three generations of progeny, since 1946, a constant gradual improvement in development of meat type as measured by weight, length of keel, width of breast fleshing, and feathering has been attained without a lessening of egg production among the better families. The importance of the sire has again been emphasized and appears to be increasingly important as the work progresses.

In the current year, 1,473 chicks from four hatches from seven breeding pens of Barred Plymouth Rocks and four of the Rhode Island Reds have been utilized. This generation has not yet reached an age suitable for statistical analysis of progress achieved in developing a superior meat type bird while maintaining egg production.

MARKET EGG PRODUCTION IN MAINE. A. E. Watson. Information was obtained from 115 poultrymen for the year ending July 31, 1947. Nearly 63 per cent of the laying birds kept were sex-linked cross. Production in smaller flocks, under 250 layers, averaged 188 eggs per layer as compared with 160 eggs in flocks averaging over 1,500 layers. The hatching date of layers did not influence egg production per bird but did influence egg size. Flocks made up of late birds hatched between May and October produced nearly 13 per cent more large eggs than flocks with earlier hatching dates. Of the eggs produced, nearly 96 per cent were sold through wholesale outlets, about 2 per cent were sold retail at the farm and less than 3 per cent were used at home by the operator and his family.

Live poultry sales were equivalent to 91 per cent and dressed poultry 9 per cent of the total volume sold. There was indication that improvement in the handling and dressing procedure used on many farms would result in better quality dressed poultry. The results of this study were published as Bulletin 462, Market Egg Production in Maine, December 1948.

PRODUCTION AND MARKETING OF HATCHING EGGS IN MAINE. A. E. Watson, C. H. Merchant. This is a cooperative project financed in part with Research & Marketing Act funds and undertaken in connection with the Northeastern Regional Project on Marketing Hatching Eggs and Baby Chicks. Personal interviews were made with 171 Maine poultrymen who sold hatching eggs at least part of the year ending November 30, 1947.

²⁹ Financial assistance was given this project through a grant from C. M. Cox Company.

During the past five years New Hampshires have replaced Rhode Island Reds as the most important breed kept by hatching egg producers. Of the eggs produced 49 per cent were sold as hatching eggs, 6 per cent were incubated on the farms and 45 per cent sold as market eggs. Hatching eggs sold were 38 per cent from straight run matings, 50 per cent from broiler crosses and 12 per cent from sex-linked crosses. Over one-half, 58 per cent, of the hatching eggs sold were produced by poultrymen selling hatching eggs during 10 or more months during the year.

The average premium received for hatching eggs from all matings was 22.6 cents per dozen with the highest premium being paid for sex-linked eggs. Hatcheries in New Hampshire and on the Del-Mar-Va peninsular were the largest receivers of Maine hatching eggs. Trucks were the most important method of transporting hatching eggs as 78 per cent of all the eggs shipped were moved by truck. A manuscript has been prepared covering the results of this study which should be ready for publication in the near future.

MARKETING OF EGGS THROUGH COUNTRY DEALERS, WHOLESALE RECEIVERS AND COOPERATIVES. A. E. Watson, C. H. Merchant. This is a cooperative regional study which is financed primarily by funds from the Research and Marketing Act of 1946. This project, which is still in progress, will describe the marketing agencies involved, services performed by the various agencies, as well as the costs involved in marketing table eggs. Special emphasis is being placed on finding out what happens to the quality of eggs in the marketing process. Identical eggs will have been examined for quality at the farm and plants of country buyers in August, November, February, and May. A limited number of lots will be re-examined after traveling from a country receiving plant into the Boston market.

Preliminary results indicate that nearly two dozen eggs per case are below "A" quality when they leave the farm and that this has increased to two and one-half dozens when they reach Boston. Improper handling and packing by producers and rough handling by egg buyers appear to be the more important factors affecting quality.

PRICES

ADJUSTMENTS IN MAINE AGRICULTURE AND FARM PRICES. C. H. Merchant, Jeanne E. McKenney. This study shows graphically and statistically the major changes which have taken place with each important crop and livestock product produced in Maine. Also, statistical material is presented on farm prices received by Maine farmers and those for the country as a whole, before, during, and after World War

II. This report is available as Miscellaneous Publication 615, Adjustments in Maine Agriculture and Farm Prices, December 1948.

SHEEP

EARLY VERSUS LATE LAMBING. H. C. Dickey. Comparisons are being made of the results of breeding purebred Oxford ewes in September for February lambing with similar ewes bred in December for May lambing. The early-bred ewes lambed an average of 2.0 lambs each, while the late-bred ewes averaged 1.4 lambs each. This would indicate that breeding ewes on pasture may cause greater ovulation and thus more twinning.

The chief problem concerned with early lambing is that of raising the young lambs. Because of cold weather in February it is necessary to have the ewes lamb in a warm room at 65° F. Of the early lambs 28.4 per cent were born dead or died soon after birth as compared with 21.4 per cent for the late lambs. The average fleece weight in May of the early-lambing ewes was 8.9 pounds while the late-lambing ewes averaged 8.4 pounds.

SOIL TESTING

SOIL TESTING LABORATORY. P. N. Carpenter. A total of 8,603 soil samples were analyzed as a farmer service during the calendar year 1948. These samples were tested for acidity (pH), readily soluble phosphorus, potassium, calcium, and magnesium. Upon request by greenhouse men, nitrate nitrogen was determined in their samples. A charge of 50 cents was made for each sample tested.

Soil samples analyzed in connection with research projects decreased slightly during the year to a total of 1,576 analyses. Analyses made on these samples were for organic matter, total nitrogen, exchangeable calcium, exchangeable potassium, soluble phosphorous and pH.

A markedly increased number of plant tissue samples from potatoes, corn, apple leaves, and blueberries were analyzed. A total of 3,524 analyses for total nitrogen, phosphorus, potassium, calcium and magnesium were made.

STRAWBERRIES

STRAWBERRY VARIETY TRIALS. R. M. Bailey, L. E. Littlefield, E. F. Murphy, Donald Folsom. Tests of new strawberry varieties were continued at Highmoor Farm in the effort to locate red stele resistant ones that compare favorably with Howard 17 and Catskill, both of which are highly susceptible to this disease. Of the varieties known to be

resistant, *Temple* appears to be of most promise. It has compared favorably with Howard 17 in two years trials at Highmoor, producing firm high quality berries with the peak of ripening two or three days later. Like Howard 17 it can be considered only "fair" for freezing. *Sparkle* is also resistant, ripens the bulk of its crop about 5 days later, and produces firm high quality fruit considered "good" for freezing. Its performance in yield and as a plant maker did not equal *Temple* last season. Both varieties deserve trial by growers. Three unnamed seedling varieties No. 55, 81, and 127 obtained by crossing Aberdeen x Howard 17 appear promising on the basis of red stele resistance, hardiness, productivity and berry characteristics. These have been placed in cooperative trials in eight widely separated towns to aid in determining if of sufficient merit to give a name and release to the public.

VITAMIN C VALUES OF MAINE-GROWN STRAWBERRIES. E. F. Murphy, R. M. Bailey. The 20 varieties of strawberries grown at Highmoor Farm varied in vitamin C content from 44.8 to 74.7 mg. per 100 grams of fresh fruit. The five leading varieties were Catskill, Robinson, Sparkle, N.J. 923, and N.J. 947. Four seedlings with low values of less than 50 mg. were S-77, S-40, S-50, and S-42. All of the seedlings are progeny of Aberdeen, which in previous seasons has consistently been on a relatively low level.

The values of 20 varieties averaged 59.9 mg. on July 9 and 55.1 mg. on July 15, a significant decrease.

Seven of the varieties (S-81, S-55, S-7, S-127, Sparkle, Howard 17, and Temple) were quick-frozen. Whole strawberries frozen with 1 part of sugar to 4 of berries ranged in vitamin C value in December from 25.1 (S-55) to 44.9 (Sparkle) mg. per 100 grams. Whole berries frozen with 1 part of sugar to 3 of berries varied from 34.8 (S-127) to 63.7 (Sparkle). No conclusions may be drawn regarding the protective influence of sugar, however, as the berries were not harvested on the same day and the fresh values may have differed. Sliced strawberries frozen with 1 part of sugar to 3 of berries showed vitamin C values during January of 23.1 mg. (S-55) to 51.9 mg. (Sparkle) per 100 grams.

A final test in April after nearly 10 months' storage of 5 varieties of whole berries with 1 part sugar to 3 parts berries gave values ranging from 21.2 (S-55) to 33.5 (S-81) mg. per 100 grams. These data demonstrate that home-frozen strawberries retain vitamin C in relatively large amounts even after 10 months' storage. A serving of one hundred grams or approximately $\frac{1}{3}$ cupful would furnish from 28 to 45 per cent of the daily adult requirement of vitamin C. This contribution would be larger in December and January.

WEED CONTROL IN STRAWBERRIES. A. E. Prince, R. M. Bailey, Robert Littlefield. Howard 17 plants were treated with four chemical herbicides thirty-five days after setting. The 2,4-D materials were used at a rate of $\frac{1}{2}$ pound of 2,4-D acid per acre, and the dinitro at 1 gallon of the 13 per cent concentrate per acre in 100 gallons of water.

Weed control was partially satisfactory where the 2,4-D ethyl ester was applied, but the material injured some of the strawberry plants and killed others. Weed control was not satisfactory with the sodium or morpholine salt of 2,4-D, or with dinitro, Sinox W. The resistant broad-leaved species and grasses more than made up for the susceptible weeds that were killed.

Two year old strawberry beds also were treated, when in flower, with herbicides at the same rates as above to determine their effect on weeds and the various strawberry varieties with the possibility of using chemicals for renovating old beds. These preliminary trials indicated that the chemicals used would not be satisfactory in renovating old beds because weed control was poor.

Howard 17 was not visibly damaged by the 2,4-D sodium salt, but was slightly injured by 2,4-D triethanolamine salt, and was more injured by 2,4-D isopropyl ester, and by Sinox W.

SUGAR BEETS

YIELDS OF SUGAR BEETS AT PRESQUE ISLE. G. L. Terman, A. S. Getchell, Michael Goven. Sugar beets were grown on a strongly acid Caribou gravelly loam soil having a pH of 4.65. Where 600 pounds of 6-9-9 fertilizer alone was applied broadcast, the very low yield of 1.6 tons of beets was obtained per acre. An additional 2000 pounds of 6-9-9 applied in row side bands increased the yield to 4.9 tons. Applying 1500 pounds of ground limestone broadcast in addition to the fertilizer increased the yield to 8.0 tons. The highest yield of 10.1 tons of beets was obtained by applying 500 pounds of ground limestone in the row prior to seeding, in addition to the fertilizer. Applying 1000 pounds of ground limestone in this way did not further increase yield. The average yield of sugar was 322 pounds of sucrose per ton of beets, which was not appreciably affected by type of fertilization.

Considerable difficulty from numerous small stones and gravel in the soil was encountered in seeding the beets. Plants emerged and grew slowly during cool, rainy weather following seeding on June 3. There was considerable injury of the plants by flea beetles early in the season and some injury by aphids later.

Results from this preliminary trial indicate that production of sugar beets on the less stony or gravelly potato soils is feasible. Proper atten-

tion to fertilization, liming and pest control should result in satisfactory yields. Machinery used for potatoes could be largely adapted to the fertilization, cultivation, pest control and harvesting operations necessary for sugar beets.

SUNFLOWERS

SUNFLOWER TRIALS. C. H. Moran, B. E. Plummer, Jr. A selected group of sunflower varieties were tested in 1948 at both Highmoor and Aroostook Farms to determine their suitability for seed and oil production. The varieties tested included 3 semi-dwarf types, and 2 tall Russian types. The semi-dwarf selections produced yields up to 1900 pounds of seed per acre when the plants were spaced 6 inches apart in the row. At plant spacings of 18 inches in 36 inch rows the yield was only 1200 pounds of seed per acre. The tall Russian selections were found to mature too late to be satisfactory for seed purposes in northern Maine.

The oil content of the whole seeds was found to vary from 24 to 31 per cent. There was no apparent effect of spacing on the percentage of oil found.

TOMATOES

TOMATO VARIETY TRIALS. E. F. Murphy, L. E. Littlefield, M. Gov-en, J. H. Waring, Reiner Bonde. Twenty varieties of tomatoes were on trial at Presque Isle and Orono, and 36 at Highmoor Farm. On September 1, Abel, Gloriana and Chatham were among the 5 highest producers in both Presque Isle and Orono. By September 15, Pritchard x Earliana, Early Trellis, Danmark, Pritchard x 44-9, and Michigan 4502 were highest yielding in Orono (5.6 to 6.9 pounds per plant), while FNC, Gloriana, Abel, Chatham, and Redskin produced most in Presque Isle (2.3 to 3.0 pounds per plant). The varieties which produced least in both of these localities included Valiant, Red Jacket, Gem, and Harkness. Among the hybrids tested, FNC x Bounty yielded well in Orono by September 1, and Pritchard x Earliana and Pritchard x 44-9 were among the top 5 yielders by September 15. None of the hybrids was high yielding at Presque Isle.

At Highmoor Farm, the top yielding varieties up to September 1 were FNC, Sr. 28-43 x FNC, Pritchard x Sr. 28-43, FNC x Sioux, and Earliana. Of these five leading varieties, the third and fourth were the most promising. For yields up to September 15, the preferred varieties were Danmark, Earliana, Bonny Best, Pritchard x Sr. 28-43, and FNC x Sioux. Bonny Best appeared slightly superior because of the larger size and better uniformity. Danmark is attractive, medium in size, and a heavy yielder, but is considered inferior in flavor.

NUTRITIVE VALUE OF MAINE TOMATOES. E. F. Murphy.³⁰ The vitamin C content was obtained for 20 varieties of tomatoes grown in Presque Isle and in Orono, and of a number of varieties and hybrids grown at Highmoor Farm. The vitamin content varied by variety from 15.1 to 30.9 mg. per 100 grams of fresh fruit in Presque Isle, from 15.4 to 24.4 mg. in Orono, and from 18.2 to 29.3 mg. at Highmoor Farm. The five highest varieties included High C, Early Trellis, and FNC both in Presque Isle and Orono. Other leading varieties in the former location were FNC x Bounty and Allred; and in the latter location were Abel and Valiant. In the Highmoor trials the leaders were High C, Quebec 5, FNC x Earliana, FNC, and FNC x Sioux. The lowest valued varieties included Gloriana, Red Jacket, Danmark, and Harkness in both Presque Isle and Orono; Pritchard x Earliana and Bonny Best also were in one of the low groups in these two areas. At Highmoor the lowest varieties were Red River x Sioux, Pritchard x Earliana, Earliana x Valiant, 28-43 x FNC, and Earliana.

Significant differences in vitamin C content occurred between dates when tomatoes were harvested. At Presque Isle the highest value was on September 9 (24.5 mg.) and the lowest on August 27-31 (17.5 mg.). At Orono the highest was on August 23 (19.7 mg.) and the lowest on August 30 (17.1 mg.).

There were no significant differences in the vitamin C content of the Presque Isle and Orono tomatoes. Evidently the environmental conditions influencing vitamin C synthesis were the same in both localities.

The vitamin A or carotene content of the 20 varieties grown in Orono varied from 2.91 to 4.73 micrograms per gram of fresh tomatoes. The highest varieties (above 4.0) were Allred, Abel, Bounty, Chatham, Pritchard x Earliana, and Bonny Best. The lowest varieties were Gloriana, Valiant, Red Jacket, Redskin, and FNC x Bounty. The variety differences, however, were not statistically significant.

PALATABILITY OF NEW VARIETIES. E. F. Murphy, M. R. Covell. FNC x Bounty were rated as highly palatable; Red Jacket was medium to high, Gem and Gloriana were medium to low; and High C, Pritchard x 44-9, and FNC x Chatham were on a low level of palatability. The palatability tests for 21 varieties previously tested during 1946 and 1947 were published a year ago.³¹

VEGETABLE CROPS

CAULIFLOWER. L. E. Littlefield. From a trial of five varieties or strains the variety known as *Burpecana* gave the highest yield of market-

³⁰ Lyle Littlefield cooperated by furnishing tomatoes for Highmoor Farm.

³¹ Maine Agr. Exp. Sta. Bul. 460:66. 1948.

able heads, and was more uniform in time of maturity. Compared with this variety were three strains of *Snowball* and *Dry Weather*. There was no significant difference between performance of the three *Snowball* strains.

CUCUMBERS. R. M. Bailey, L. E. Littlefield, Donald Folsom. Further crosses and selections are being made for a scab resistant pickling type. As a secondary objective attempts are being made toward securing a better scab resistant slicing variety to perhaps replace *Highmoor*.

LETTUCE. L. E. Littlefield, Joseph Hickey.³² From trials conducted at Highmoor Farm and cooperative trials sponsored by the Extension Service with five growers, a comparison was made between *Penn Lake* and *Early Great Lakes* (Premier Great Lakes). Both are new varieties coming from the Penn. State College. Results of these trials indicated that these two varieties will grow well under Maine conditions, and yields on both varieties were reported as good. *Early Great Lakes* had resistance to tip burn, was 7-10 days earlier than regular Great Lakes, and received most favorable comment from growers.

PEAS. L. E. Littlefield. Trials consisted primarily of introductions from India. A few of these showed promise from the standpoint of drought resistance, and being used as possible breeding stock. Pod size of many was as good as for Maine commercial varieties.

SQUASH. L. E. Littlefield. From trials of thirty-two varieties of winter squash the only varieties that might replace the present ones grown in Maine would be the bush types of *Buttercup* and *Table Queen*. These two bush types would give a slight increase in production per acre. Of the Hubbard group, *Kitchenette* showed up as a possible solution for the ones wishing an 8-10 pound squash of near Hubbard texture and shape.

VEGETABLE DISEASE CONTROL. M. T. Hilborn. Hot, dry weather during the growing season prevented late blight from becoming established on the tomato spray plots, and prevented halo blight on the bean plots. Bioquin I (an organic fungicide containing copper), Dithane Z-78, Good-rite z.a.c., Parzate, Tribasic Copper Sulphate, Zerlate, No. 658 (copper-zinc-chromate), and a mixture of copper nitrodithioacetate and zinc nitrodithioacetate all were applied to tomatoes without visible spray injury or serious reduction in yield rate when compared with unsprayed plots. Zinc nitrodithioacetate when used alone on tomatoes caused severe spray injury.

Bioquin I, Dithane Z-78, Phygon, and Zerlate also caused no visible spray injury to beans and no appreciable reduction in yield when compared with unsprayed control plots.

³² Cooperative Project Maine Extension Service.

DDT showed promise in the control of lettuce yellows on large scale experiments in cooperation with commercial growers in 1948. The DDT was applied as a 3 per cent dust at 5 times during the growing season. The disease was considerably reduced on the dusted plots, being 6 per cent in the treated plots as compared with 77 per cent on the untreated controls.

INSPECTION SERVICE

INSPECTION SERVICE. E. R. Tobey, C. H. White, B. E. Plummer, Jr., M. G. Moore, E. O. Merrill, J. S. Getchell, G. A. Waddell, Fay Hyland. The Commissioner of Agriculture is the executive of the laws regulating the sale of fertilizers, agricultural seeds, insecticides, fungicides, foods, drugs, and feeding stuffs in Maine. It is the duty of the Director of the Maine Agricultural Experiment Station to analyze or cause to be analyzed the samples collected by the Commissioner and to publish the results of the analyses together with the names of the persons from whom the samples were obtained and such additional information as may seem advisable. This information is reported in the Official Inspections published during the year. The State Tax Assessor is the executive of the laws regulating the sale of gasoline and motor lubricants. It is the duty of the Director of the Station to analyze or cause to be analyzed the samples collected by the State Tax Assessor but no provision has been made for the publication of the results of the analyses.

A brief summary of the work of inspection is as follows:

Testing of Dairy Glassware. It is required by law that all Babcock glassware used in Maine by creameries, ice cream factories or others buying or selling milk or cream on a basis of the butterfat content, must be tested for accuracy at the Maine Agricultural Experiment Station. A total of 1,458 pieces have been examined during the past year. Four pieces were not passed.

Fertilizer Inspection. A total of 288 samples of fertilizer materials were collected and analyzed. Of these samples, 233 were mixed fertilizers containing nitrogen, phosphoric acid, potash, and in some of the samples, magnesium and borax. The samples of mixed fertilizers represented 141 different brands. Of the total number of samples received 53 were found to be below guaranty in total nitrogen, 53 in available phosphoric acid, 17 in total phosphoric acid, 30 in soluble potash, 8 in total magnesium, and 1 in total calcium.

This year many more samples of individual brands were taken than during the last few years. This increased number of analyses gives a much better understanding of the quality of fertilizer sold in Maine. The number of deficiencies in comparison with the guaranties shows a

decrease from the previous year of 3 per cent in total nitrogen deficiencies and 6 per cent in available phosphoric acid deficiencies. This indicates an improvement in the quality of fertilizer sold in Maine in 1948.

The results of the analyses are reported in Official Inspections 209.

Agricultural Seeds Inspection; Fungicides and Insecticides Inspection. A total of 100 official samples of seeds and 150 official samples of fungicides and insecticides were analyzed. Most of the seed samples showed satisfactory agreement between guaranties and results found in laboratory tests. The greatest differences in results of germination tests, as guaranteed and found, occurred in the legumes such as clover. In most cases the differences could be accounted for by changes in hard seed content. In most instances the hard seed content decreased in storage with a corresponding increase in laboratory germination. In a few cases the reverse occurred. As in previous years there were too many samples where the noxious weed content was not represented on the label.

An examination of the results of analyses of the official samples of fungicides and insecticides shows a much higher relative number of deficiencies in comparison to guaranties than occurred last year. This increase, based upon the total number of deficiencies as compared to the total number of samples, is 13 per cent.

The results of the analyses are reported in Official Inspections 210.

Foods Inspection. The number and variety of official samples collected and submitted depend upon the nature of the inspection work carried on by the Division of Inspection and the State Dairy Inspector, Augusta, Maine, in the enforcement of the food and dairy laws. A total number of 5,631 samples have been received and examined chemically, bacteriologically, or both. Included in this number are 4,459 samples of dairy products, mostly official samples of milk and cream; 80 official samples of bread; 120 official samples of oil used in packing sardines; 73 official samples of shellfish; 67 official samples of sea water; and 367 miscellaneous samples. The majority of the miscellaneous samples, consisting of milk and cream, were examined for municipal departments of health and private individuals. Also included with the miscellaneous samples are a small number of official samples of ale and maple products.

Of the 3,939 official samples of milk, 4 samples of raw milk were found to contain added water. The summary of the results of analyses of milk and cream shows a general trend toward improvement in all categories. The number of milk samples meeting State standards increased 3.6 per cent and the number of cream samples 9.0 per cent.

It is interesting to note that the results of analyses of the samples

of bread indicate that the requirements of the law will be met, in all probability, if the bakers use enriched flour or unenriched flour plus enrichment tablets according to the manufacturers' directions.

A cooperative study was made with the United States Department of Health of closed clam areas and 465 samples of shellfish, silt, and sea water were analyzed for bacterial pollution.

The results of the analyses are reported in Official Inspections 211.

Feeding Stuffs Inspection. A total of 701 samples of feeding stuffs were received and the percentages of protein, fat and fiber in these samples were determined. Thirty-three samples were found to be below guaranty in protein, 9 of which showed a deficiency of 5 per cent or more of the protein guaranty. Seventy-eight samples were found to be below guaranty in fat and 69 samples exceeded the maximum guaranty in fiber.

The results of the inspection, as shown by the number of deficiencies in comparison with the guaranties, indicate a net decrease in the number of deficiencies of approximately 7 per cent as compared to the previous year.

The results of the analyses are reported in Official Inspections 212.

Gasoline and Motor Lubricants Inspection. A total of 236 samples of gasoline were received. The results of the analyses indicated that all but 2 of these samples complied with the specification of the Maine law regulating the sale of motor gasoline, namely, that the maximum temperature for complete distillation shall not exceed 437° F.

Twenty-one of the 106 samples of motor oils, which were examined, failed to meet the manufacturers' specifications for the respective brands asked for by the inspector.

WEATHER

The autumn drought of 1947 continued well into the winter of 1948 with a consequent serious shortage of hydro electric power. During January and February 1948 sub-zero temperatures prevailed all over Maine and heavy snowfalls occurred in all sections except Aroostook county. In mid-February, rain and thawed snow were absorbed into the unfrozen ground, but precipitation was still below normal. Mild weather came in mid-March with no flood damage. A mild April showed above normal but unevenly distributed precipitation so that dry conditions prevailed at the end of the month with rain needed for agriculture and fire prevention. Excess rain in May (2.34 in. above normal) and part of June, with subnormal temperatures during both months (1.8° and 2.3° below normal) delayed planting and retarded normal vegetation. The latter part of June and all of July were favorable and presaged a near

normal harvest. Dry weather, however, in August and September especially in the Penobscot Bay region (2.05 and 2.32 inches of rain below normal) affected pastures, corn, fruit, berry, and vegetable crops of central and southern Maine. Northern Aroostook escaped the August drought with near normal rainfall. Numerous fires were controlled by extreme vigilance. Early September was unusually warm.

The 1948 growing season in central Maine was from May 4 to September 17. November was mild (6.5° above normal) with heavy well-distributed rainfall (2.51 in. above normal). December was unseasonably warm (6.3° above normal) and ended practically snowless except in northern Maine where 5 inches fell the last of the month. Lack of snow and mild weather continued into the winter of 1949.

Weather recording equipment has been installed by the U. S. Weather Bureau at Blueberry Hill Farm and complete records are available since January 1, 1949. These records and those for Highmoor Farm are included in the following summary. Weather information also is obtained by the Station staff at Aroostook Farm, which is published monthly by the U. S. Weather Bureau in Climatological Data for the U. S. by Sections.

Summary of Weather Data at Highmoor and Blueberry Hill Farms

Month	Temperature			Total inches precipitation	No. of days with .01 inch or more precipitation
	Average	Max.	Min.		
Highmoor Farm at Monmouth:					
July '48	69.1	91	48	2.21	10
Aug.	69.6	97	50	1.75	7
Sept.	60.1	88	35	1.15	5
Oct.	47.8	83	20	3.08	10
Nov.	41.8	64	22	7.05	19
Dec.	27.6	53	0	4.47	7
Jan. '49	24.8	50	0	4.00	14
Feb.	23.0	54	-9	3.00	11
March	30.0	61	5	3.08	14
April	45.3	72	23	4.07	12
May	55.0	83	32	3.15	14
June	66.0	89	41	2.65	8
Blueberry Hill Farm at Jonesboro:					
Jan. '49	23.8	50	-3	3.99	7
Feb.	22.8	58	-10	5.31	8
March	29.7	60	0	2.14	5
April	45.2	64	25	4.00	10
May	52.8	79	31	2.98	7
June	62.4	88	32	2.07	5

PUBLICATIONS.

The results of the work of the Experiment Station are published in 4 separate series, which during the year 1948-49 included 13 Experiment Station Bulletins, 4 Official Inspections, 4 Miscellaneous Publications, and several Mimeographed Reports. The mimeographed report series, which was started this year, is for limited distribution, primarily for departmental use by the author. With the present use of the mimeographed series, all miscellaneous publications are printed. The Report of Progress is the final experiment station bulletin of the year.

One copy of each of these printed publications is furnished without charge upon request to the Agricultural Experiment Station at Orono, Maine. Those who request having their names placed on the mailing list receive a card, at least annually, listing the new available publications. A list of all currently available bulletins also can be obtained upon request.

The findings and recommendations of the research staff are distributed through a number of channels in addition to the Station Publications. During 1948-49, a total of 12 articles were published in scientific journals, 24 articles were published in agricultural magazines, and numerous short news releases were printed in the newspapers. Many of the bulletins and circulars issued by the Maine Extension Service also are based on research by the Maine Station, and in some cases are written by members of the Station Staff.

Other methods of distributing research information by the Station staff included the presentation of 12 papers at scientific meetings, 22 radio talks, and 122 talks at farm meetings. The Station staff members also have provided through correspondence and personal interviews considerable technical information to individuals who have sought their advice and assistance. This service has included the identification of a large number of samples of insects, diseases, and other materials. Members also have been active on a large number of research committees and in serving as officers of important agricultural organizations.

The following is a list of Experiment Station publications issued during 1948-49.

End

EXPERIMENT STATION BULLETINS:

- No. 461. Selecting a Dairy Bull. H. W. Hall, H. C. Dickey, and A. O. Shaw. November, 1948. 42 pages.
- No. 462. Market Egg Production in Maine. Andrew E. Watson. December, 1948. 28 pages.
- No. 463. Effects of Certain Soil Conditions and Treatments Upon Potato Yields and the Development and Control of Potato Scab. G. L. Terman, F. H. Steinmetz, and Arthur Hawkins. December, 1948. 31 pages.

- No. 464. Comparative Effects of Certain Sulphur Fungicides on McIntosh Apple Trees. Donald Folsom. December, 1948. 31 pages.
- No. 465. Consumers' Acceptance of Sized Potatoes. Charles H. Merchant. December, 1948. 15 pages.
- No. 466. Quality of Potatoes in Retail Stores in Boston, Massachusetts, and Maine Markets, 1948. Charles H. Merchant and Homer C. Woodward. February, 1949. 62 pages.
- No. 467. Increasing Plant Stand in Blueberry Fields. C. W. Hitz. February, 1949. 27 pages.
- No. 468. European Corn Borer Control. John H. Hawkins. March, 1949. 15 pages.
- No. 469. Maine Potato Diseases, Insects, and Injuries. Donald Folsom, G. W. Simpson, and Reiner Bonde. May, 1949. 49 pages.
- No. 470. Progress on Some Important Insect and Disease Problems of Irish Potato Production in Maine. G. W. Simpson and W. A. Shands. May, 1949. 50 pages.
- No. 471. Control of Potato Late-Blight Tuber Rot. R. Bonde and E. S. Schultz. May, 1949. 16 pages.
- No. 472. Practices, Costs, and Tuber Bruising in Digging Potatoes in Aroostook County, Maine. W. E. Schrupf. June, 1949. 53 pages.
- No. 473. Research for Maine Farmers, Sixty-fifth Annual Report of Progress, Year Ending June 30, 1949. June, 1949. 84 pages.

OFFICIAL INSPECTIONS:

- No. 208. Commercial Feeding Stuffs, 1947-48. Elmer R. Tobey. July, 1948. 34 pages.
- No. 209. Commercial Fertilizers, 1948. Elmer R. Tobey. October, 1948. 36 pages.
- No. 210. Commercial Agricultural Seeds, 1948, F. Hyland; Fungicides and Insecticides, 1948, Elmer R. Tobey. December, 1948. 30 pages.
- No. 211. Foods. Elmer R. Tobey. June, 1949. 21 pages.

MISCELLANEOUS PUBLICATIONS:

- No. 612. Solving Your Blueberry Problems. July, 1948. 13 pages.
- No. 613. Pest Control Materials, 1949. D. E. H. Frear, M. T. Hilborn, and A. E. Prince. January, 1949. 110 pages. Also issued as Penna. Agr. Exp. Sta. Progress Report No. 4.
- No. 614. Blueberry Research and Service. January, 1949. 16 pages.
- No. 615. Adjustments in Maine Agriculture and Farm Prices. Charles H. Merchant and Jeanne E. McKenney. December, 1948. 69 pages.

MIMEOGRAPHED REPORTS: (for limited distribution by research departments)

- No. 1. 1948 Small Grain Trials. C. H. Moran. November, 1948. 5 pages.
- No. 2. Cooperative Potato Variety Trials in 1948. W. C. Libby and R. V. Akeley. December, 1948. 6 pages.

- No. 3. Chemical Weed Control in Potatoes in Aroostook County, Maine During Summer of 1948. P. J. Eastman. February, 1949. 2 pages.
- Forage Crops Recommendations for 1949. C. H. Moran. March, 1949. 9 pages.
- No. 4. 1948 Potato Vine Killing Trials. P. J. Eastman. March, 1949. 6 pages.
- No. 5. The New Experimental Potato Storage House. H. D. Bartlett. April, 1949. 2 pages.

ARTICLES IN SCIENTIFIC JOURNALS:

- Ashman, R. I. and A. D. Nutting. The Effect of Utilization and Cutting Practices on the Forest and Wood Industries in the Northeast. Proceedings Society of American Foresters' Meeting, Boston 1948.
- Baker, Gregory. Kiln Drying of Turnery Squares and Turned Products. Northeastern Wood Utilization Council, Inc. Bul. No. 23, pp. 47-52. August, 1948.
- Bonde, Reiner. Spraying Potatoes for Control of Diseases and Insects in Maine. Amer. Potato Journal 26:90. 1949.
- Bonde, Reiner and Mildred Covell. Effect of Variety and Other Factors on Pathogenicity of Potato Ring-Rot Bacteria. Accepted for publication in Jour. Agr. Research. April, 1949.
- Bonde, Reiner. Results of Testing Different Potato Seedling Progenies for Resistance to Ring Rot. National Potato Breeding Program. 19th Annual Report 1948.
- Folsom, Donald. A Ten-year Apple Spray Test. Annual report of the Maine State Pomological Society 1947. pp. 36-37.
- Hawkins, J. H. Some Phases of European Corn Borer Control in Central Maine. Jour. Econ. Entomology 42:306-311. 1949.
- Hilborn, M. T. and F. H. Steinmetz. Relation of Time of Cutting to Rate of Decay of Beech, Birch, and Spruce Under Natural Storage Conditions. Phytopath. 39:11. 1949. (abst.)
- Hovey, Charles and Reiner Bonde. *Physalis Angulata* L. a Test Plant for the Potato Leafroll Virus. Phytopath. 38:505-507. 1948.
- Lathrop, F. H. Biology of the Plum Curculio in Maine. Jour. Econ. Entomology 42:12-18. 1949.
- Terman, G. L. and J. K. Freeman (Ky.). Interpretation of Yield Data from a Long-time Soil Fertility Experiment. Jour. Amer. Soc. Agronomy 40:874-884. 1948.
- Ward, Gerald M. and Vearl R. Smith. Total Milk Production as Affected by Time of Milking After Application of a Conditioned Stimulus. Jour. Dairy Science 32:17-21. January 1949.

FINANCIAL REPORT

The total income of the Station during the year ending June 30, 1949, was \$489,452.95. Of this amount 32.4 per cent was from Federal funds, 20.6 per cent from the State Mill Tax, 15.3 per cent from industry taxes on potatoes and blueberries, 12.0 per cent from service work in inspection analysis and Florida potato tests, 3.7 per cent from special research grants, and 16.0 per cent from the sale of farm products and miscellaneous income.

The Station received an increase of slightly over \$4000 from appropriations under the Research and Marketing Act of 1946. In addition, an allocation of \$4000 of Title II funds under this Act was made late in 1948-49 for a project on the marketing of Maine potatoes. It is anticipated that this will be supplemented with an additional allocation in 1949-50.

The allocation from Potato Tax funds was increased approximately \$7000 to total \$55,720 for this fiscal year. The amount of the Blueberry Tax funds also was increased approximately \$3000. The income from sales of farm produce was up appreciably for 1948-49 over the previous year. The income from the sale of potatoes from the Aroostook Farm and the Soil Erosion Farm for the 1948 potato crop was slightly over the total expense for operating these two farms during 1948-49. This is a record that will seldom be duplicated because the unit cost of production is much higher for the small experimental plot work than for commercial farm production.

Special grants of funds were received from ten commercial concerns and two government agencies, as shown in the footnote below the following table summarizing income and expenses. More details as to expenditures are given in the second table.

**Summary of Income and Expenditures of
The Maine Agricultural Experiment Station
July 1, 1948 to June 30, 1949**

Source of funds	Total income	Per cent of income	Total expenditures
Hatch Act	\$ 15,000.00	3.1	\$ 15,000.00
Adams Act	15,000.00	3.1	15,000.00
Purnell Act	60,000.00	12.2	60,000.00
Bankhead-Jones Act	24,124.05	4.9	24,124.05
Research and Marketing Act	44,356.34	9.1	37,356.34
Total Federal funds	\$158,480.39	32.4	\$151,480.39
State Mill Tax	\$100,602.50	20.6	\$101,182.79
Potato Tax	55,719.82	11.4	55,719.82
Blueberry Tax and farm sales	18,897.11	3.9	19,923.75
Inspection Analysis	26,093.79	5.3	26,093.79
Florida potato test	32,824.88	6.7	31,794.54
Sales and service ¹	77,517.89	15.8	62,490.29
Potato storage house ²	1,200.00	.2	13,060.29
Special research grants ³	18,116.57	3.7	19,112.68
Total all funds	\$489,452.95	100.0	\$480,858.34

¹ Includes soil testing work, and income from farm products other than from Blueberry Hill Farm.

² The income of \$1200.00 was received from additional State Mill Tax funds; the remainder of expenditures was met from balance of sales fund on hand at the end of the year June 30, 1948.

³ Special research grants were received from:

Sweet Corn Tax Receipts, through the Maine Department of Agriculture, for corn borer research

Kraft Foods Company for Irish moss investigations

Eastern States Farmers' Exchange for studies on production of efficient size seed potatoes

C. M. Cox Company for poultry breeding studies

E. I. DuPont de Nemours Company for potato fungicide spray tests

Maine Sea and Shore Fisheries, through the Maine Development Commission, for lobster study

General Chemical Company for potato spraying and dusting experiments

Tennessee Corporation for potato fungicide tests

Sherwin Williams Company for experiments on chemical weed control

Summers Fertilizer Company, through James E. Totman, for potato fertilizer research

Maine Cannery Association for sweet corn breeding research

Maine Institute of Potato Starch Manufacturers which provided equipment and a building for drying starch plant waste

Classification of Expenditures by the Maine Agricultural Experiment Station
July 1, 1948 to June 30, 1949

Source of funds	Personal services	Supplies, materials	Travel	Equipment	Repairs, alterations	Printing, binding	Utilities, rent	Transportation, communication	Land, buildings
Hatch Act	\$ 11,942.12	\$ 1,105.18	\$ 316.92	\$ 470.61	\$ 94.07	\$ 186.00	\$ 545.91	\$ 339.19	\$ —
Adams Act	14,297.77	614.96	75.80	1.92	9.55	—	—	—	—
Purnell Act	44,020.79	11,071.34	1,468.87	1,430.37	510.84	271.59	1,105.31	60.89	—
Bankhead-Jones Act	20,192.00	1,243.71	818.75	806.92	350.92	568.02	40.60	36.53	66.00
Research and Marketing Act	28,273.39	1,519.57	5,391.16	881.75	67.21	822.63	253.46	147.17	—
Total Federal funds	\$118,726.07	\$15,554.76	\$ 8,071.50	\$ 3,391.57	\$ 1,032.59	\$1,848.84	\$ 2,005.28	\$ 583.78	\$ 66.00
State Mill Tax	\$ 72,440.24	\$ 6,320.65	\$ 5,583.68	\$ 5,670.51	\$ 3,175.82	\$4,524.08	\$ 2,032.83	\$1,434.98	\$ —
Potato Tax	36,723.82	5,622.06	3,116.51	6,373.85	1,414.32	12.82	626.09	519.77	1,210.53
Blueberry Tax, farm sales	8,941.10	2,949.96	992.09	2,467.51	1,792.50	680.65	473.81	222.46	1,400.67
Inspection Analysis	22,653.36	1,702.66	291.29	363.71	95.75	—	332.89	341.13	—
Florida potato test	3,213.09	476.18	5,248.54	100.00	—	—	13,090.00	3,066.43	—
Sales and service	36,337.45	17,723.75	46.78	2,128.19	3,972.58	—	1,355.47	647.29	78.75
Potato storage house	—	—	—	—	—	—	—	—	13,060.29
Special research grants	12,783.75	1,720.87	852.76	1,889.90	1,060.82	—	20.36	184.22	—
Total all funds	\$317,848.91	\$51,870.89	\$34,173.45	\$22,725.24	\$13,147.38	\$7,046.39	\$20,938.73	\$7,391.06	\$15,816.29

